A new intensity
Programmes under pressure

A&D Insights

Industrial Products
Aerospace & Defence

The third edition in our
A&D Insights series

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Methodology

As part of this report, PwC interviewed 28 senior executives from 23 leading Aerospace and Defence (A&D) companies in Brazil, Canada, France, Germany, the United Kingdom and the United States. The combined sales revenues of the companies exceeded US$338 billion in 2011. The interviews took place in person between February 2012 and May 2012. Questions focused on programme management effectiveness and profitability as well as the impact of changing dynamics from market shifts and globalisation. The results of the interviews are supported by additional proprietary research, as well as analysis of publicly available information. The results are reported in US dollars unless specified otherwise.

Introduction

Neil Hampson
Global Aerospace &
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A&D Insights 2012, the third in this annual series, looks at the challenges facing programme management as the industry responds to an unprecedented convergence of pressures in the environment in which today's programmes are being delivered.

Healthy order books in the commercial airline sector sit alongside sluggish recovery in corporate aviation and retrenchment in defence. Commercial sector buoyancy is coming largely from growth markets such as the Middle East and Asia. In contrast, western markets are considerably more brittle. The defence sector is adjusting to the new reality of western government austerity measures and seeking to diversify its international footprint. All this, while the global economic outlook continues to be clouded by considerable uncertainty arising from the eurozone crisis.

In a world of convergent pressures, we conclude that companies will need a different kind of programme management mindset in which partnership, internationalism, inclusivity and innovation are as much to the fore as really good 'get it out of the door' programme management.

In an era of fierce international competition, the winners will need to show that they can also use innovation as a key competitive advantage to bring value-addition to customers alongside price-sensitivity. Deploying a host of innovative strategies to anticipate, understand and match customers' needs in changing international markets will be an important part of programme success. We conclude our report by looking at the qualities that companies will need to deliver future programme management success.

Executive summary

Aerospace and defence companies face a new intensity in the delivery of their programmes. The need to be faster, fitter and lower cost while managing growing programme complexity goes with the territory. These are considerable challenges in their own right but they are being given a new intensity by the unprecedented environment in which today's programmes are being delivered.

A&D companies are experiencing more pressure from more directions than ever before—on price, supply chain risk, the need to expand globally, the risks associated therewith and broader macro-economic uncertainty. Alongside this, customers expect that innovation will continue while costs come down or are capped. Innovation is a must-have but can no longer come at any price. This convergence of pressures is leading to a change in programme management that moves it well beyond its traditional heartland of scheduling, progress tracking, managing risk and pressurising or sometimes penalising suppliers.

How can companies respond to this convergence of pressures? In the past, companies would respond to pressure by majoring on excellence in one of solutions leadership, operational excellence or customer intimacy. But today's environment means that excellence in one alone is not enough. Companies, and in turn their programme managers, need to be top of their game in all three. And they need to be able to deliver innovation and affordability in tandem.

We invited the senior executives we interviewed to identify the programme management attributes they feel are most important in the current and future environment. They painted a picture of a different kind of programme management mindset in which partnership, internationalism, inclusivity and innovation are as much to the fore as really good 'get it out of the door' programme management. For example, 64% of the senior executives we interviewed stressed the importance of innovation as a source of competitive advantage when asked to identify the most important aspects of their programme delivery strategy. They also emphasised the importance of being able to deliver

64%

of the senior executives stressed the importance of innovation as a source of competitive advantage

programmes in a way that is much more strongly integrated into the customer, market and supply chain forces that are shaping the sector.

There is a strong trend towards more inclusive partnering relationships with the supply base and with the customer. These partnerships are being used to co-define a product or service, share risk in the design and production cycle, enter new markets and deliver through-life services. This trend to greater inclusiveness is reflected in the greater emphasis being placed on joint ventures and partnerships in programme delivery strategies. Joint ventures and partnerships, alongside management of globalised supply chains and tight control of programme costs, were second only to the importance of innovation in the minds of the senior executives we interviewed.

Innovation, systems integration and affordability need to go hand in hand. In the competitive environment faced by A&D companies, it is not good enough just to wait to compete on contracts anymore. Instead, companies are bringing innovation into their business model to get really close to their customers and the supply chain to try to be ahead of what the market needs and wants. 'Co-creation', where the customer has significant input to the end product through structured approaches, can result in a much closer match between budgets and requirements.

The downturn in western defence markets and the continued internationalisation of both the defence and the commercial sectors have accelerated the trend to greater globalisation of supply chains. But as supply chains extend so too does risk. More inclusive relationships across and down the supply chain can help manage these risks and ensure they are jointly identified and mitigated rather than debated and litigated.

Such an intense and complex environment brings dangers. How can companies cut through this? Our discussions with senior executives, and our review of what they said, led us to identify the following things that companies need to make sure they get right:

Stay focused on your core

Identify and understand what you do best and make sure that focus guides your key decisions. Just because the industry is heading in a certain direction, such as globalising the supply chain, doesn't mean it is always best for you. A clear understanding of what you do best and what others do best is fundamental to your make-buy decisions. For example, there might be situations where you may need to co-locate design teams under one roof because certain capabilities are required from partners across the globe but the expertise for virtual management of complex tasks in a breakthrough technology does not currently exist within your organisation. You must know what you do well, focus on that, and measure performance.

Put an emphasis on co-creation and customer intimacy

Develop relations with your customers and suppliers that are really tight, so that requirements are exactly understood, developed together and put at the heart of programme design and execution. Paying close attention to detailed design upfront and aligning it to customer requirements can go a long way to reducing programme profitability problems. Good customer intimacy can be used to pre-plan efficiencies across the programme lifecycle.

Get innovation and cost control working in tandem

The previous ability of customers to tolerate price drift no longer exists. Companies will need to deliver more capability at lower cost, becoming adept at combining cost reduction strategies with 'innovation ready' derivative platforms.

These overarching strategies in turn provide the context for the programme management approach needed to deliver future programme success. Programme managers will need to:

Look hard at systems integration

Programmes generally stand or fall on how well companies succeed in managing an inherently complex network of interlocking platforms and technologies from different suppliers. Unless you can get integration of this jigsaw right, don't make it even more complex by extending it further. If you can't get it right, then maybe a greater degree of vertical integration is what is needed.

Put partnerships and JVs on firm foundations

Have the right approach to culture, governance, contractual terms, transparency and create an environment where critical information flows when and where it is needed.

Develop real agility and speed in business processes

Use this as a valuable differentiator, enabling adaptation to new products, services and markets in months not years.

Become world citizens in relationship management

Build the skills and cultural outlook as programme leaders and within your team to manage global programme footprints and the partnerships that go with it.

Develop the 'softer skills' needed to take a collaborative approach to supply chain risk

Get good at sharing risk information, taking coordinated action to manage risks and being more open about vulnerabilities.

Finally, programme managers need great judgment. The importance of speed and agility means that it's not always going to be possible to have 100% of the data before making decisions. In such situations, good judgment based on sound experience and a focus on what the company knows and does best is everything. Companies that can move forward fast when maybe they only have a fraction of the data are going to gain a competitive edge. But such talent is in short supply and companies need to be good at recognising and developing it.

> Companies are bringing innovation into their business model to get really close to the customer and try to be ahead of what they need and want.

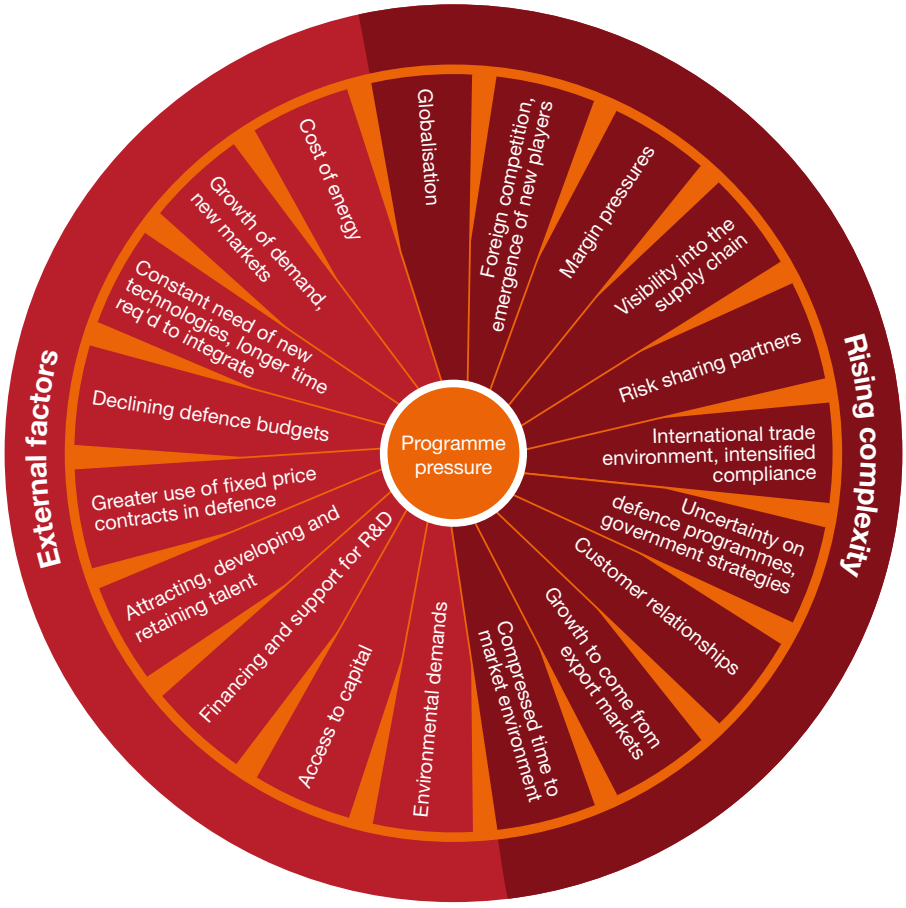
A convergence of pressure

The intensity and combination of pressures facing A&D companies is reflected in the range of challenges identified by the leading senior industry executives we interviewed for this report (figure 1). Programmes are coming under more pressure from more directions. Reductions in major defence platform programmes are coinciding with more but higher risk commercial programmes. For companies serving both markets, the effect of the upturn in commercial orders offsetting the shrinking of traditional defence markets is welcome but this can introduce programme development challenges where platforms and technologies are interdependent. In the background, continuing world economic uncertainties, particularly in the eurozone and possible softening of Chinese growth, pose concerns about economic growth and further possible pressure on military budgets.

Market pressures

The simultaneous convergence of pressure is markedly different from previous periods. The market environment in both the commercial and defence segments is strongly price-sensitive. But there is still a need to deliver product that can enable technological innovation, for example in terms of greater functionality, reduced operating costs and environmental improvements. At the same time, the banking crisis and tighter financial market conditions have put pressure on financing and support for R&D and access to capital, not just on primes but most significantly on tier-one suppliers and beyond. This can introduce significant programme risk through the supply chain.

Figure 1: Biggest challenges for A&D overall programme performance



In defence, there has been an extension of the use of fixed price contracts in the US in particular, elevating contractor risk. The public sector is more than ever holding companies and programme managers accountable for failing to meet schedules, budgets, and performance specifications. Nan Bouchard, vice president of program management, Boeing Defense, Space & Security (BDS) points out: *"We're seeing an attempt to reduce technical risk on programmes so that cost can be more assured and contained. We're also seeing a shift of risk to industry in more of a fixed-price environment. It's different than the way programmes have been run in this last cycle. Both on the customer side and on the industry side; people are not used to running programmes in a fixed-price context where you have to be more mindful of what the baseline is, and to manage closely to that baseline."*

At the same time as these potentially constraining factors have to be managed, the programme environment is also one of great opportunity and expansion. High production rate ramp-up will be needed across much of the sector. Airbus, Boeing, Bombardier and Embraer have all announced a series of record deals for their new generation of commercial aircraft. Military programmes such as the Joint Strike Fighter and Tanker with extensive supply participants are also ramping up in the next five to ten years, albeit slower than previously anticipated.

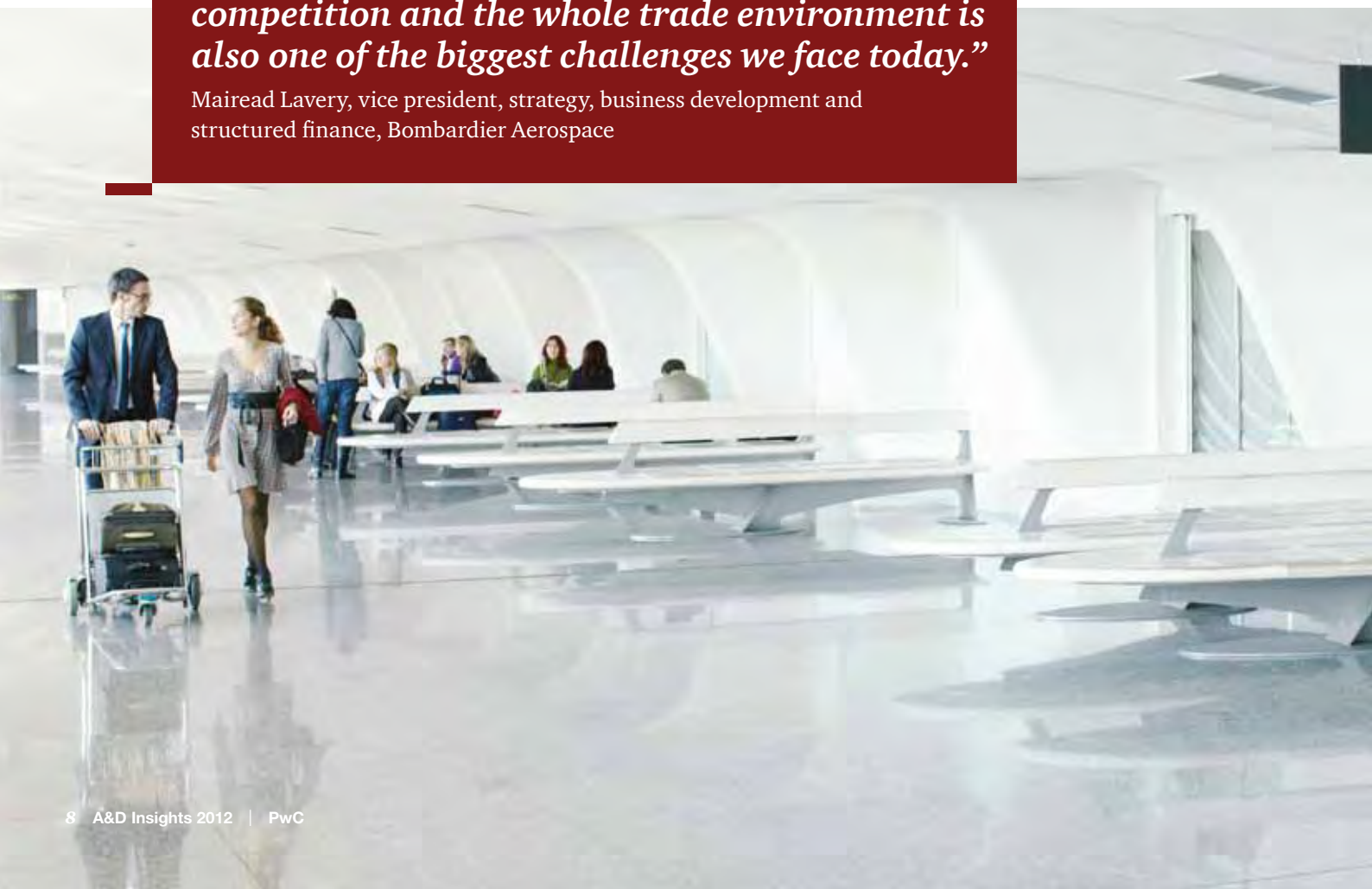
But big rate increases also mean pressure on the supply chain, leaving programmes vulnerable to supply chain disruption (delay or failure). It will be important that companies learn from previous programme issues where delays or failure have arisen from factors such as immature technologies, engineering and supply chain complexity, supplier constraints and over-optimistic scheduling or lack of planning for contingencies.

Internationalisation of markets and supply chains

The globalisation of the A&D industry has accelerated over the past few years and this trend is further intensifying as both the defence and commercial segments look to capture business in growth regions of the world, notably the Middle East, Asia and South America. On the defence side, there is the heightened international competition for these new markets, highlighted recently by the contest between the four-nation Eurofighter

"The risk management associated with the supply base is huge and volatility in the economy is a change from the past. Cycles are getting shorter and more volatile, putting pressure on previous reliance on existing core long-term business which are needed to support programme development. International competition and the whole trade environment is also one of the biggest challenges we face today."

Mairead Lavery, vice president, strategy, business development and structured finance, Bombardier Aerospace



Typhoon and Dassault Aviation's Rafale jet to become the preferred bidder to supply medium multi-role combat aircraft to India's air force. On the commercial side, the Commercial Aircraft Corporation of China (Comac) is seeking to challenge the duopoly of Airbus and Boeing.

Alongside market globalisation, supply chains have internationalised, giving companies opportunities to source production at optimal cost and in optimal locations for offsets and subsequent exports. But this adds to supply chain complexity and significantly increases the profile of risks such as geopolitical, international trade and business conduct compliance. The emergence of new competition around the world is bringing opportunities for western suppliers who now have customer opportunities with a much greater geographic spread of manufacturers. For example, Laurent Rasmont, Ratier Figeac's vice president in charge of engineering, quality and programmes, observes: *"Historically, our client base was located only in North America, western Europe and Latin America. Progressively, we are extending our client base to Asia and Russia."*

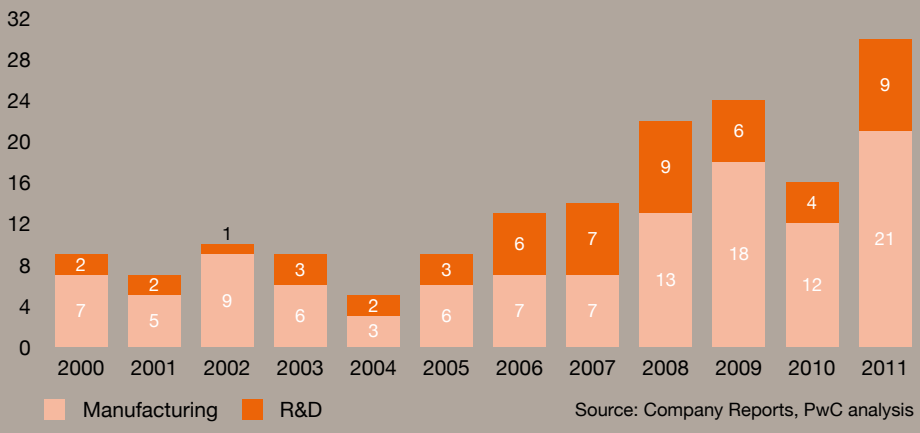
Internationalisation was an important theme highlighted by all the companies that we interviewed for this report. French defence company DCNS has moved from a position a decade ago where its main revenue came from French defence and export accounted only for around 15% of revenue. Now, Andreas Loewenstein, DCNS's senior vice president for strategy and development, says: *"Export accounts for 35% and should jump up to 70% ten years from now."* Similarly, EADS' defence division Cassidian, now has a global presence, having seen its export share rise from 10% to 30-35% today with a target of around 55% in ten years.

Asked to compare important sales revenue markets now and in ten years' time, the companies we spoke to identified China, India and Latin America as high growth markets together with the rest of Asia and the Middle East as also being important. The markets of North America and western Europe are currently the two largest markets for these companies but they are relatively mature and seen as having less future growth importance compared to newer markets elsewhere. While western Europe was expected to deliver fairly flat growth, central and eastern Europe, Russia and North America were identified as offering slightly better growth prospects.

Globalisation of new investment

The number of investments in international markets (i.e. investments in markets outside of the 'home' country of the investing company) by the top 50 aerospace and defence companies reached a new high in 2011 (figure 2a). Twenty one new manufacturing investments and nine research and development (R&D) investments were added in 2011. Two thirds of R&D investments were in countries outside of North America, the UK and western Europe. Thirteen of the 21 new manufacturing investments added in 2011 came from outside these regions. Interestingly, there was also a pick-up of manufacturing investments in Europe and North America. Indeed, in 2011 unlike in the previous two years, such investments outnumbered those in India and China.

Figure 2a: Number of investments by top 50 global A&D companies in international markets (2000-2011)



Source: Company Reports, PwC analysis

Figure 2b: Number of investments by top 50 global A&D companies by country (cumulative 2000-2011)

R&D and manufacturing investments by country, 2000-2011 (cumulative)

Country/Region	R&D
India	12
US	7
Russia	6
UK	5
China	4
W Europe	4
CEE	3
Middle East	3
Mexico	2
S Korea	2
N. Africa	1
Other	5
Total	**54**

Other in 2009: Singapore, Australia
Other in 2010: Uzbekistan
Other in 2011: Canada

Country/Region	Manufacturing
China	23
India	20
US	15
Mexico	10
Russia	9
Middle East	8
UK	7
W Europe	7
CEE	4
N Africa	4
S Korea	2
Other	5
Total	**114**

Other in 2009: Brazil
Other in 2010: Brazil(2)
Other in 2011: Kazakhstan

Notes: Top 50 companies as per Flight International Top 100 Rankings. Includes organic investments and discrete aerospace JVs where rationale for investment is known. Excludes acquisitions.

Source: Company Reports, PwC analysis

Greater complexity

A&D programmes have always been complex. However, the complexity of programme requirements has intensified significantly over the past few years. Most of today's major programmes have a systems-of-systems approach, an inherently complex network of interlocking platforms and technologies that requires the precise integration and unerring performance of disparate pieces. This also requires the successful programme management of each of the systems—an undertaking that can be significantly challenged when suppliers thrust into an unfamiliar subsystem integration role fail to meet schedules, cost caps or capability promises.

On top of this, the internationalisation trends that we have outlined above have further compounded the complexity, introducing greater geographical reach and bringing new relationship matrices into play. Many of the senior executives we interviewed emphasised that it is not just technological complexity. As Peter Fielder, managing director of performance excellence at BAE Systems puts it: *"It is the mix of factors, not just purely technical complexity. It's different markets, different supply chain partners, different technologies, different relationships. We're having to address factors that we have not had to address in the past. For example, you may have multiple partner buyers as well as multiple partner suppliers."*

Complexity is also arising from the sheer pace of technological change which is accelerating in most areas of the sector. Bill Fitzgerald, president for commercial engines at GE Aviation, observes: *"Our market position today comes from a technological legacy that has been developed over 40 years. But the pace of change now means that in the next five to seven years we will cover another 40 years. That's a challenge for the industry. One big question is whether there will be enough engineering resources industry-wide."*

> ***"Complexity is coming from the changing environment. Customers are facing into difficult budget situations and, as we internationalise more, there's more complexity in those relationships. The challenge for all of us, both from the industry and the government side, is to deal effectively with that new environment."***
>
> Nan Bouchard, vice president of program management, Boeing Defense, Space & Security (BDS)

Margin pressures

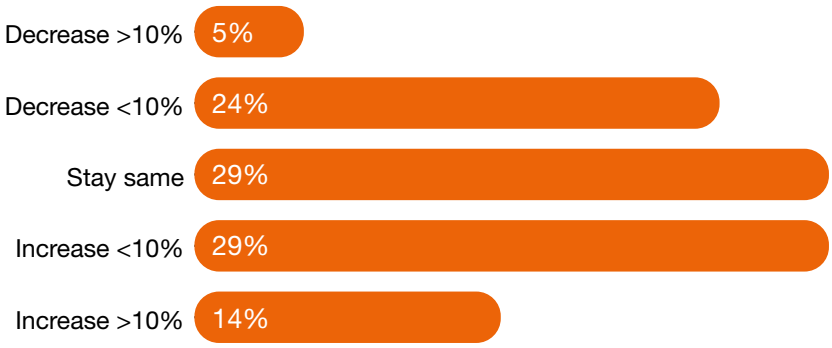
The countervailing forces prevalent in the A&D sector are reflected in divergent views on the outlook for programme profit margins in the coming decade. Just under half (43%) of the senior executives in the companies we interviewed felt margins would improve in the next ten years with the rest split between them staying the same or reducing (figure 3).

With considerable pressure for price reduction or containment from both commercial and military customers, scope for margin improvement will need to come from reduced input costs or programme efficiencies. With much of the former being dependent on wider commodity prices, companies will need to look to their own internal programmes, such as lean initiatives, to deliver. In some cases, there may also be scope for shifts in emphasis within programmes to higher margin opportunities.

European space company, Astrium, for example is looking towards more emphasis on services in its mix of infrastructure and service business as a route to better profit margins. But, like other companies, it is also putting a strong emphasis on exploring lower cost sourcing opportunities and keeping tight control of programme costs. Other companies are facing threats to the higher margin areas of their programme life cycles. One senior executive heading the electronic systems division of a world-leading aerospace company observes: *"MROs are up-and-coming—taking our aftermarket profitability away."*

In the defence sector, government austerity programmes continue to exert downward pressure on pricing. It is strongly felt on both sides of the Atlantic and is coming alongside other changes by government buyers. For example, Klaus-Peter Leinauer, vice president sales & business development at RUAG Aerospace Services points out: *"One of the main challenges for our defence division represents the reorganisation and the budget cuts of the German Federal Armed Forces, which will likely also enforce the monopolisation process of our market."*

Figure 3: What do you think will happen to programme profit margins over the next 10 years?



Programme volume

Most of the interviewees we spoke to expected the number of programmes that they rely on for the vast majority of their revenue to increase rather than decrease in the coming decade. Embraer, for example, has moved from a single programme for 80% of its revenue a decade ago to four programmes today (Phenom, Legacy 600, Legacy 650 and KC 390). It expects the number to double in ten years' time. Bombardier has seen similar programme expansion, moving from four or five to 11 today and expects to be delivering about 15 programmes in a decade's time for the vast majority of its revenue.

Programme volumes vary considerably according to the nature of the product being manufactured and some companies report that they expect future revenues to be concentrated on a smaller number of programmes. For example, Dan Gobel, vice president and deputy general manager of BAE Systems Electronic Systems sector in the US, observes that they have 4,000-6,000 programmes under management, of which 10-20% are over US$2 million but that the number accounting for 80% of revenue is shrinking and that will continue to be the case. *"I think the 1990s are coming back to bite us now. As we went through the downturn in the nineties we gathered up a generation of engineers. And now it's coming back to haunt us 20 years later because we've lost a generation. We as an industry encouraged a generation to get out of defence."*

At the other end of the spectrum, defence combat specialist General Dynamics Land Systems focuses only on one or two programmes, currently the Abrams tank and the Stryker family of light armoured vehicles, for its main revenue volume. Similarly Rolls-Royce's submarine nuclear propulsion division has moved from 20 or so small contracts a decade ago to five large contracts today, and the division anticipates one single, integrated contract for the entire fleet management in ten years' time.

> ***"We'll be going from a fewer number of huge programmes to many smaller and more developmental type programmes. Yesterday there were hundreds of massive, multi-year programmes with more being cost-plus type contracts. Today and in the future there will be thousands of smaller, shorter, development type programmes. It's a different environment and requires identifying and managing risks way up front much more effectively."***
>
> Major US defence contractor

Responding to the programme management challenges

The new environment of multiple and converging pressures intensifies the challenges faced by programme managers. They are working in an environment where customers are asking for increased capabilities but at lower cost. This puts pressure on programme management to innovate while also containing cost. How well positioned are companies? In general terms, the senior executives we interviewed are satisfied that their companies have the ability to manage complex programmes well.

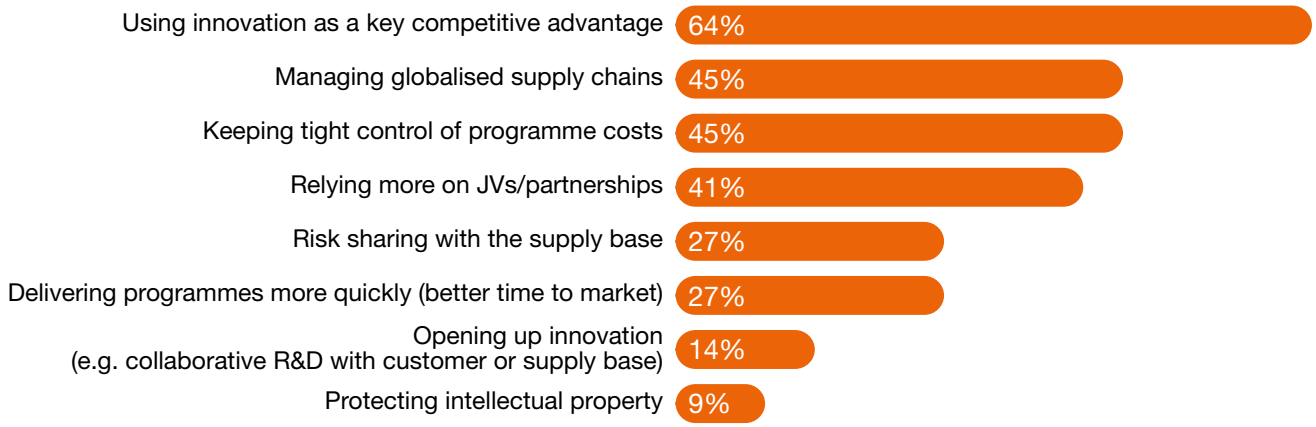
Indeed, three in every ten gave themselves a top ranking of 'excellent'. This comes despite the number of examples of cost overruns and delays in the sector. But a quarter were much more modest, rating their company's programme management ability only as 'fair'. The remainder, nearly half, while believing their company to be 'good', also recognised that there was room for improvement before they could feel it was 'excellent' (figure 4).

Figure 4: How would you rate your company's ability to manage complex programmes?

The main challenges

When invited to identify their top three programme concerns, the familiar imperatives of delivering on time, staying on budget, and meeting and managing customer requirements were the most frequently mentioned challenges. But, of course, the challenge for companies is to achieve these goals in the current changing and, in many ways, unique environment. We drilled down further and invited the senior executives to rank the issues they are focusing most closely on in the delivery of their programme goals (figure 5).

Figure 5: Most important aspects of company programme delivery strategy



"By definition, large and highly complex engineering programmes carry risk and hit problems from time to time. It's a competitive environment out there and with the current affordability challenges, it means that the industry has to be agile, innovative and bold in supporting our customers. So growth without risk seems a bit unlikely to me. Those who get it more right than wrong are the ones most likely to earn the right to be trusted with the next challenges."

Peter Fielder, managing director of performance excellence at BAE Systems

Using innovation as a key competitive advantage

The responses from senior executives highlight the extent to which a technological and innovative edge is seen as the key way to survive and thrive in a highly competitive environment. Putting innovation into the heart of programme delivery strategy was emphasised time and time again by the senior executives we spoke with. But innovation brings technology risk. Recent big programme examples show how difficult it is to introduce innovative technologies on time.

A vital part of success is aligning innovation with clear customer benefit, most importantly cost reduction for customers. Company innovations need to be rooted first and foremost in understanding of customers and how their problems can be solved better. Energy affordability, for example, is a big concern for customers and the introduction of lighter aircraft and more fuel efficient technology is now a 'must have' in the commercial sector. But to survive, aircraft and engine manufacturers will need to be able to introduce further fuel efficiency 'game changers'.

Unlike in earlier periods in the evolution of the sector, the industry cannot afford to wait for technologies to develop as programmes develop. As Ratier Figeac's Laurent Rasmont points out: *"New technologies need to be mature right away. Airbus or Boeing can't give suppliers time to develop their technology over the course of a aircraft programme anymore. The technological step is too big to take any kind of risk and the ramp-up is too important as Airbus and Boeing have a record number of new orders. They can't have any delays because of immature technologies."*

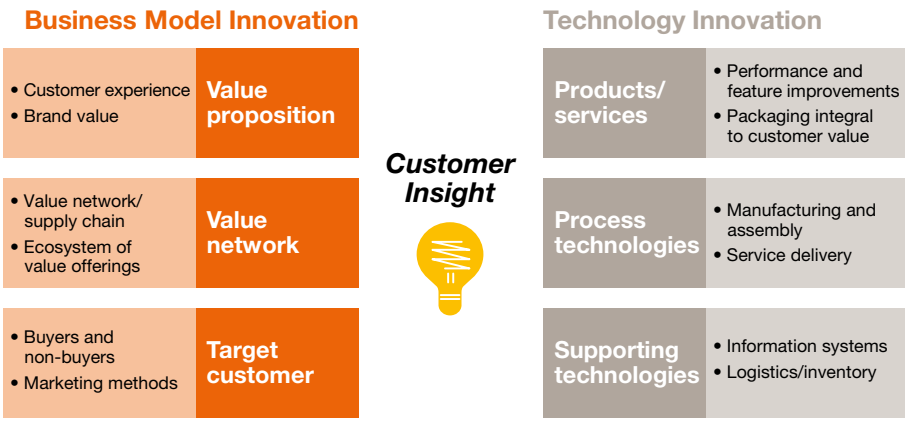
Strong and well financed research and development plans are essential for companies to produce robust and reliable technology. In the past, manufacturers such as Airbus or Boeing helped their suppliers finance their research programmes but, as Rasmont observes: *"Those days are clearly over. Tier-one suppliers must show that they're able to finance their R&D on their own. In that regard, government actions such as R&D tax credits have been a great help."*

Aerospace and defence companies are deploying a range of strategies to ensure innovation is an integral part of programme delivery. Among them, Dassault uses 'technology roadmaps' to identify 15 technologies that give it differentiation and then converge these onto a single product. One major US defence contractor uses innovation websites that employees and suppliers have access to and puts an emphasis on incentivisation of innovation by its engineers with awards and CEO involvement.

Most companies emphasise technology innovation and underutilise business model innovation. Some companies are looking at more innovative models for their business processes and doing this in conjunction with their customers. General Dynamic Land Systems (GDLS), for example, is developing an innovative government contracting approach to secure the best mix of vehicles and lock in future prices. GDLS's Mike Cannon, senior vice president ground combat systems, also adds: *"With all the pressure on the domestic market and a lot of saturation as well, taking our product global is a big priority. But innovation is probably number two. And it's not innovation in a traditional sense. It's innovation in how we approach our clients."* The trend in the defence sector towards performance-based or outcome-based contracts is also an illustration of business model innovation.

This is having a significant impact on programmes, as programme management teams need to understand how their programme is expected to deliver value (figure 6) and to feel comfortable managing it. Michael Joyce, senior vice president, operations and programme management with Lockheed Martin, observes: *"For the past eight to ten years, government and industry have developed an impressive portfolio of new innovation. Now the programmatic challenge is to produce and field these new innovations in an affordable manner."*

Figure 6



Source: *Making Innovation Work*, Davila, Epstein, Shelton: Wharton School Publishing, 2006

Relying more on joint ventures and partnerships

Many senior executives emphasised the growing importance of joint ventures (JVs) and partnerships. JVs are an important way into new markets and continue to be an important popular business model to share risks and leverage the complementary resources and capabilities of the participants. But they also present challenges in financial risk sharing rules and in structuring clear and well-documented technical and managerial interfaces. These challenges are even more onerous when the JV relationship spans multiple countries and cultures. It is essential for companies to be clear about when it is appropriate to choose a JV approach and when other partnership approaches may be better.

Whatever the chosen model, it is important for the participants to invest time in making it work. Important building blocks for any such initiatives include a shared 'whole partnership' approach to risk, as well as visibility and transparency right across the programme, a coherent master schedule linked to all partners, shared programme management space and capacity. Adrian Ellis, Rolls-Royce's director of next generation submarines, recalls the commitment needed to establish the operating model for the UK's Successor new nuclear submarine programme: *"It took considerable senior level time and effort. You can't expect a complex project team to just work. It needs investment."*

The complexity of modern A&D programmes and the need for genuine collaboration also means that partnership participants need to be ready to change their style and approach to joint initiatives and leave hierarchical or contractual attitudes at home. Again, Rolls-Royce's Adrian Ellis observes: *"We see a much more partnered type of management emerging as the future of complex programmes rather than one party being in the sole lead and directing the others. No one party has all the capabilities to deliver these complex programmes."*

Risk sharing with partners

In past years, ineffective management of supply chain risks has resulted in cost overruns, production delays, quality failures and, in some cases, penalties and order/programme cancellations. And the increasing search for international partners and customers is creating ever more complicated risks. Individual suppliers cannot always identify and respond to these risks alone and, often, processes and controls at prime contractors don't capture them. Working in isolation, both primes and suppliers can be blind to many emerging supply chain risks.

Taking a shared approach to risk identification is increasingly important in the aerospace and defence supply chain. Bombardier's Mairead Lavery says: *"We have been very public about the fact that we enter into risk sharing partner relationships. We focus very much on what we call supplier development, which includes supplier assessment and development and monitoring to make sure we have the right risk partner."*

Being able to properly monitor and take a shared approach to risk also means capacity-building down the supply chain. Lavery's colleague, Robert Dewar, vice president and general manager CSeries at Bombardier Aerospace, says: *"When we started the Global Express jet programme we managed the tier-ones but had a lot of learning as well. Of course, a lot of the tier-one suppliers have to manage the tier-twos and, in turn, the tier-threes so they are also in a learning curve on how to do that. We make sure we have good governance in place and that they're able to manage that well with our help."* This overall governance is especially important as Safran's Jean-Pierre Cojan, deputy CEO for strategy and development, points out: *"Tier-one contractors cannot really flow-down the risk-sharing partnership concept as tier-two and tier-three companies are financially too small."*

One senior US defence company executive stressed the importance of *"vetting suppliers early, sharing information across the business and getting them involved with the customer early."* Risk sharing needs to be reflected in contract design: *"If we have a fixed price with a customer, then suppliers need to share in that accountability. There should be the same rules for suppliers as the prime has. There should be a flow-down of requirements, quality standards and fixed cost pressures. Without it, no amount of engineers can solve a fundamentally bad contract."*

Effective partnership relationships are delivering significant benefits in a number of ways:

- Large risks that transcend, what were in the past, individual company boundaries are jointly managed and mitigated rather than debated and litigated.
- Waste is removed from programmes by joint governance which smoothes the partner interfaces and optimises resource costs, usually the largest proportion of development programmes.
- 'Co-creation', where the customer and the supply chain have significant input to the end product through structured approaches results in a much closer match between budget and requirements.

But the experience of the A&D industry also shows that effective partnerships are not always easy to deliver. For example, while the cost of risk can be shared throughout a commercial aircraft supply base, there's little point in the Original Equipment Manufacturer (OEM) extracting ever greater financial penalties from a failing supplier when the entire aircraft is delayed. Also, in meeting the requirements of export contracts, 'offsets' of design and production contracts are almost always required to help the receiving country establish its own capabilities. If the chosen partners cannot deliver, this can jeopardise an otherwise successful contract. And, if decisions in supplier selection are based on offset obligations to create capability in an unproven supplier, it does introduce additional risk even though it may be required by the agreed offset obligation.

Finally, we heard from one senior executive involved in a large defence contract who said that the contract partners were willing to cooperate and the cultural environment was supportive. But because the different partners' design and production systems did not talk to each other, exchanging critical programme information relied on an intensive manual check of thousands of data items to identify any changes made since the last data exchange. Another senior executive, Hervé Multon, senior vice president of strategy for Thales, highlighted the importance of creating a wider common culture as programme management becomes increasingly global: *"It is necessary to harmonise programme management processes. Our programme managers come from different cultural backgrounds. This is an internal training challenge to provide an enterprise culture to our people who have different backgrounds and training, as well as living in societies with very different cultures in place."*

What all these cameos show is that programme management has moved beyond the mechanistic: create schedules, track progress, manage risk, pressure suppliers for improved performance and withhold payment if goals are not met. In today's programmes, leaders must pay much more attention to the set-up and running of partnered relationships if they are to succeed. PwC's experience in establishing successful partnerships identifies some critical elements:

- Culture – matching styles to ensure no unnecessary friction, includes assigning personnel who are suited to the joint environment.
- Governance – low overhead but effective management at all levels not just through traditional review meetings.
- Environment – programme data, design data, production information, communication links, all are essential to get right before critical information starts flowing.
- Contractual terms – must promote the desired operating model not lead to protectionism and claims against other partners.
- Transparency – to build trust which is the foundation of successful relationships.

Deeper customer intimacy

Deeper customer intimacy is delivering benefits in a number of areas. In the UK, for example, the Ministry of Defence (MoD) is a full partner in the Submarine Enterprise Performance Programme (SEPP) along with Rolls-Royce, BAE Systems and Babcock Marine. From this position, the MoD, as the customer, can engage with its partners in dynamic trade-off decisions and risk mitigation actions throughout the programme chain, resulting in a more tightly managed programme. Another UK defence example is in Complex Weapon Systems where the MoD works in partnership with industry members making trade-offs between new equipment design and existing equipment support to give maximum capability from a fixed budget.

Globalising or just exporting?

In a recent PwC study, 30 companies were interviewed on how they are addressing the globalisation challenge. The research revealed that the globalisation journey occurs in three distinct phases, which we have named *Export*, *Regionalise*, and *Originate*. Companies and industries do not move smoothly through these phases. Progression is disruptive, and, when one company changes the game, an entire industry can be forced to respond. But, as a general rule, progression through the phases depends on the maturity of the company's globalisation strategy and on the complexity of the challenges in question. The research also confirmed that senior managers consider the same nine dimensions in their globalization efforts, regardless of the company's industry or size (figure 7).

Figure 7: Many companies are struggling to move beyond the 'export mindset'

Market Reach	National Champions, still dominated by the 'Export' mindset
Market Offering	Focusing on home region offerings at emerging market prices
Operations	Driving cost-down and managing offsets
Procurement	Improving Low Cost Country supply of lower-end technologies
IP Development	Mainly tightly-controlled from the home region
Capital	Accessed through home markets
Talent	Hiring locally but home region dominates the leadership team
Operating Model	No consistent view on the best model for partnerships
Governance	Struggling to Integrate Regional requirements & priorities

Source: PwC survey of 30 global businesses

Managing globalised supply chains

Don Burch, chief program manager for Spirit Aerosystems, highlights the critical importance of global supply chain management: *"Managing our global supply chains really well is going to be critical for getting to where we want to be in five or ten years."* The development of global supply chains has been an important strategy for companies to reduce costs as well as to serve a worldwide customer base.

The historic focus on national home markets has meant that the defence sector has been slower to develop globalised supply chains. But this is changing fast as defence companies look for lower cost sourcing opportunities to protect margins and seek to establish a better global footing to secure orders in non-traditional markets. However, strategic trade controls such as the US International Traffic in Arms Regulations (ITAR) place many restrictions on the transfer of technical data from US primes to overseas suppliers, thus limiting the potential pool of suppliers (see panel).

The scale and complexity of modern programmes introduces a host of potential risks. As one of our interviewees from a major aircraft producer observes: *"The production of*

Adding to programme risk – strategic trade controls

Strategic trade controls represent an area of growing complexity for A&D companies, particularly in the defence sector. These measures are imposed by governments to restrict access to sensitive equipment, materials and technical data. In many cases, these restrictions are based on commitments made to multilateral export control regimes. In the US, export control policy and regulations are also used to promote national security and foreign policy objectives. Strategic trade controls include economic sanctions and embargoes as well as restrictions resulting from United Nations Security Council resolutions aimed at curbing proliferation activity.

The US is in the midst of a comprehensive export control reform initiative that is likely to introduce the most dramatic and sweeping changes in decades. In particular, the proposed movement of items from the US Munitions List (USML), subject to the ITAR, to the Commerce Control List (CCL) will introduce new licensing regimes and unanticipated complexities. The proposed change requires Congressional approval but companies would be well advised to carefully consider potential impacts before they become a reality. While many A&D companies are familiar with ITAR, moving items to the CCL may be completely new territory for programme leadership and back office support.

The US has recently created an Export Enforcement Coordination Centre to facilitate interagency cooperation in investigating allegations of export violations. Risks to companies increase exponentially as the government increasingly moves towards enforcement actions that involve multiple agencies, and thus the risk of exposure to prosecution under different laws and regulations.

The globalisation of sourcing, manufacturing, assembly and R&D carries additional risks as companies strive to comply with the import and export regulations of various countries. While many companies have processes for implementing multilateral export control regime requirements, it can be challenging to maintain current knowledge of new and changing laws in different countries. Malaysia and the United Arab Emirates (UAE), for example, have both enacted export control legislation. In 2011, Mexico joined the Wassenaar Arrangement, which is the multilateral export control regime that implements controls on dual-use items and technologies. Keeping abreast of these and other ongoing regulatory developments around the world will be both challenging and essential to maintaining effective trade compliance programs.

Improving identification of rate ramp-up risk in commercial aerospace

Managing risk in the supply chain is all the more important in commercial aerospace where the industry operating model has pushed much of the design and manufacturing work to suppliers, often in the form of risk-sharing partnerships. The current rapid programme rate ramp-up will place considerable strain on suppliers' capacity.

PwC analysed the potential capacity risks in the aerospace supply chain by identifying which suppliers' operations will be most strained by projected rate ramp-ups on key 2011–2016 growth programmes. We then mapped that against which suppliers may be worst positioned financially to invest in additional capacity. Our study covered 12 key growth programmes from five commercial and defence OEMs. We calculated required capacity growth and financial readiness scores for 93 suppliers across nine different component and system segments.

The results showed that a fifth (21%) of suppliers aren't financially ready to support the high ramp-up that is required[2]. This highlights the importance of companies using practical and rigorous approaches to assess supply chain risk and develop effective mitigation strategies. PwC has developed a model that allows companies to continually monitor and assess risk in the A&D supply chain and use that as the basis for pinpointing suppliers that need more detailed scrutiny and possible action.

In our experience, many tier-ones still need to upgrade their core capabilities to improve the reliability of their end-to-end performance in the value chain. This includes the maturity to manage their interface with their customers and the joint interface with other tier-ones, particularly the integrated performance of their core capabilities. There remains a tendency to 'firefight' or 'muscle through' to meet the ramp-up challenge. This can come at the expense of ways to really structure, monitor, and dynamically collaborate as part of an extended supply chain.

an aircraft involves a very complex logistic process. We need 65,000 parts from several suppliers. If one supplier delays the delivery, the whole process is affected." In a recent example, software problems in a remote electronics unit tied to the fly-by-wire control system for the new Embraer Legacy 500 and Legacy 450 business jets have led to a reported one-year delay in first flight and certification[1].

Also, at a time when banking and market uncertainties remain high, the importance of checks on financial as well as operational and capacity vulnerabilities can't be underestimated. There is also the need to identify 'self-inflicted risks', such as a preferred reliance on a single supplier for certain components because managers perhaps feel comfortable with its product or personnel, or because production volumes are considered too low for a dual source. This might come at the cost of overlooking vulnerabilities in the supply chain.

Our experience with many industry players suggests that current approaches to A&D supply chain risk management are either too complex or too simple. We have seen companies trying to assign an absolute probability percentage to each supply chain risk or apply an undifferentiated and resource-intensive approach of performing a detailed due diligence on each of their suppliers. At the other end of the spectrum, companies sometimes rely on internal or supplier surveys to obtain a qualitative view of supply chain risks. Both the in-depth and the 'lighter touch' approaches have limitations. Instead, companies should develop approaches to map risk continuously and quickly so that effort can be prioritised on the suppliers where risk is greatest.

> ***"The difference between good and bad risk management has a huge influence on margins."***
>
> Bernhard Gerwert,
> chief operating officer, Cassidian

1 Flight International, November 2011
2 PwC, Soaring or stalling: can aircraft manufacturers prevent rate ramp-up problems, February 2011.

Keeping tight control of costs and scheduling

Tight control of costs and scheduling has always been a key focus for A&D companies but the current era of government austerity budgets and greater international competition and pressure in the airline market has intensified the need to make sure controls are effective. As one senior executive in a US defence company comments: *"The military went from being a client to being a customer. We need uniformed military leadership to convert the buyers back into clients. Customers just look for the lowest prices."* His counterpart in a European company serving both the commercial and the military markets points out: *"Keeping tight control of programme costs is a leitmotif for the aeronautical industry."*

Understanding requirements and defining them as clearly and as early as possible is an important way of preventing cost and scheduling difficulties. But this is not easy, as DCNS's Andreas Loewenstein points out: *"The biggest cause of variability in programme profitability can be traced to design, mostly detailed design. Profitability is impacted by technical discrepancies even if one strives to identify them early in the program and correct them throughout the programme with good programme management skills."* Another senior executive in a US defence company reflects that customer indecision and lack of planning are sometimes something that is beyond their control: *"Our biggest challenge is that the government does not have a plan that we can build around. It makes us reactors rather than planners."*

Managing customer expectations is a recurrent theme that came through in our senior executive interviews: *"Programmes are more complex and developmental than they used to be. This makes requirements volatility greater, which introduces significant budgetary risk. There can be an insatiable appetite for more features and more functionality. You need a constant and disciplined contracts and configuration management or you will be left holding the bag,"* says one senior defence company executive.

The importance of being clear at the outset about the design specification of projects is emphasised by Jean-Marc Gasparini, vice president of Dassault Aviation: *"We've always played a hard game with clients to ensure they leave enough time for the design and development phase. Aeronautics is a sector where technique does not lie. Recent history has shown that you cannot put the technical dust under the carpet."* Similarly, it is important to set a realistic timetable and manage timing expectations from the start. Evert Dudok, chief executive officer of Astrium Satellites, observes: *"Customers need to be convinced about the fact that new products based on leading edge technologies will take a bit longer to develop than products based on mainstream technologies."* Best in class programme management needs to put a strong emphasis on managing the relationship with the customer through the sales and delivery cycle—to get the right price, to develop requirements and to manage expectations. As one senior executive points out: *"Running the Gantt chart is the least worry!"*

Tools such as Earned Value Management (EVM) can be a good basis for excellent work performance measurement and reporting. But the building blocks of well-defined product requirements and a realistic budget to accomplish the work must be in place to enable a programme to successfully perform. Continuous forecasting is also essential. One senior US executive confesses: *"I'm not a big fan of EVM. It looks backward. Headlights are more valuable than rear-view mirrors. We need to reserve for risk, both cost reserves and schedule reserves. I'm more worried about where we are going than where we are. Show me the spend plan—if the slope is different than expected, there is an issue."*

As well as continuous forecasting, the importance of continuous improvement was mentioned by some of those we interviewed. John Johnson, director – modernization programs at Sikorsky Aircraft Corporation, stresses: *"It is important to build continuous improvement into the organisational culture by always believing that there is a faster, cheaper, better method when you're going forward. The more you can harness all the elements around you in order to achieve this, the better off you're going to be."*

Skills and knowledge challenges

"Making sure we have skilled people on the programme is one of the main challenges we have," observes Robert Dewar, vice president and general manager CSeries at Bombardier Aerospace. His view is shared across much of the sector. Talent is a major challenge for the sector for a number of reasons. There is the demographic challenge of an ageing workforce with a large proportion of people with significant programme experience reaching retirement age. There is also a shortage of 'new skills' such as systems engineers who can manage the technical complexity of today's programmes and programme managers whose skillset can reach across the value chain.

Dan Gobel, vice president and deputy general manager of BAE Systems Electronic Systems sector in the US, observes: *"I think the 1990s are coming back to bite us now. As we went through the downturn in the nineties, we gathered up a generation of engineers. And now it's coming back to haunt us 20 years later because we've lost a generation. We encouraged a generation to get out of defence."*

A&D companies are in a race for young talent and, unlike in past eras, the sector does not quite have the same competitive advantage that came from being 'futuristic'. The sector is now more established and there are plenty of other 'buzzy' new sectors that are out there also looking for talent. *"We're competing today with healthier and 'sexier' industries,"* observes one senior executive from a leading defence contractor.

The talent challenge is especially acute on 'once in a generation' programmes. Adrian Ellis is director of next generation submarines at Rolls-Royce. He describes the successor to the ballistic nuclear submarine programme as *"one of the biggest, most complex projects in the UK for the next decade"* but points out that *"historical lack of investment in a domain as complex as submarine design means key skills have atrophied making it tough to rebuild them up from the start again. We have to rebuild that capability and we've got to do it in a context where the affordable defence budget is a real challenge. Doing something as complicated as making a ballistic submarine means that we've got to use every bit of the UK's expertise—there isn't any spare capacity in the industry."*

Capturing and retaining knowledge is also a very real issue, with the challenges being all the greater in a global context. Shane M. Wright, chief financial officer of GE Aviation, observes: *"We've been globalising our engineering group now for at least a decade. You need to be able to build proficiency and be able to integrate, connect and mentor people in a host of different countries. Using a cake analogy, you can take some great ingredients and mix them together but the thing that sets it apart is the secret sauce. And that I think is something we need to work at every day."*

> ***"Reverse mentoring is interesting. Match the 'old guys' up with some 'young folks' who can open their eyes and teach them about new capabilities and ways of doing things, and the thinking that comes with the fast evolution of technology."***
>
> US A&D senior executive

Delivering for the future

An effective programme delivery strategy is an essential foundation of future success for A&D companies. It means evaluating the markets they're already in and those they need to be in to meet financial targets. It also means understanding what factors can give them a competitive edge, whether it's doing a better job at risk sharing across the supply base, changing their contracting approach, evolving their relations with government customers, protecting intellectual property more effectively, or managing globalised supply chains.

Once companies have defined a solid strategy, they need to execute it. That's not easy, with programmes becoming more global. We think pressures on defence spending will make collaboration across the programme value chain even more important. In a successful partnership each player needs to deliver to the best of their ability—something that's doubly difficult when working across borders.

In new geographic regions, customer requirements may be different and new supply chains will need to be set up. In many cases the customer culture may have a significant impact.

We see big differences emerging between eastern and western approaches to programme delivery. These are causing significant issues for some 'traditional' primes. Even in established markets, the rules are changing. For example, many contracts now include service elements like training and maintenance that require different types of management.

When A&D companies look across industry borders to areas like cyber-security and energy for growth, they may also face very different market dynamics. For example, non-traditional competitors are using product management strategies from the more agile software sector to deliver a stream of product releases where the time-to-market is much quicker than most A&D companies can manage. Attitudes toward risk are changing too. Understanding how to manage risk and share it effectively can be an important advantage. It all adds up to re-thinking how future A&D programmes should be designed, managed and monitored.

How can companies respond to the convergence of pressures that we have outlined in this report? In the past, companies would respond to pressure by majoring on excellence in one of solutions leadership, operational excellence or customer intimacy. But today's environment means that excellence in one alone is not enough. Companies, and in turn their programme managers, need to be top of their game in all three. And they need to be able to deliver innovation and affordability in tandem. Our discussions with senior executives, and our review of what they said, led us to identify the following three things that companies need to make sure they get right:

1. Stay focused on your core

Identify and understand what you do best and make sure that focus guides your key decisions. Just because the industry is heading in a certain direction, such as globalising the supply chain, doesn't mean it is always best for you. A clear understanding of what you do best and what others do best is fundamental to your make-buy decisions. For example, there might be situations where you may need to co-locate design teams under one roof because certain capabilities are required from partners across the globe but the expertise for virtual management of complex tasks in a breakthrough technology does not currently exist within your organisation. You must know what you do well, focus on that, and measure performance.

2. Put an emphasis on co-creation and customer intimacy

Develop relations with your customers and suppliers that are really tight, so that requirements are exactly understood, developed together and put at the heart of programme design and execution. Paying close attention to detailed design upfront and aligning it to customer requirements can go a long way to reducing programme profitability problems. Good customer intimacy can be used to pre-plan efficiencies across the programme lifecycle.

3. Get innovation and cost control working in tandem

The previous ability of customers to tolerate price drift no longer exists. Companies will need to deliver more capability at lower cost, becoming adept at combining cost reduction strategies with 'innovation ready' derivative platforms.

These overarching strategies in turn provide the context for the programme management approach needed to deliver future programme success. Programme managers will need to:

Look hard at systems integration

Programmes generally stand or fall on how well companies succeed in managing an inherently complex network of interlocking platforms and technologies from different suppliers. Unless you can get integration of this jigsaw right, don't make it even more complex by extending it further. If you can't get it right, then maybe a greater degree of vertical integration is what is needed.

Put partnerships and JVs on firm foundations

Have the right approach to culture, governance, contractual terms, transparency and create an environment where critical information flows when and where it is needed.

Develop real agility and speed in business processes

Use this as a valuable differentiator, enabling adaptation to new products, services and markets in months not years.

Become world citizens in relationship management

Build the skills and cultural outlook as programme leaders and within your team to manage global programme footprints and the partnerships that go with it.

Develop the 'softer skills' needed to take a collaborative approach to supply chain risk

Get good at sharing risk information, taking coordinated action to manage risks and being more open about vulnerabilities.

Finally, programme managers need great judgment. The importance of speed and agility means that it's not always going to be possible to have 100% of the data before making decisions. In such situations, good judgment based on sound experience and a focus on what the company knows and does best is everything. Companies that can move forward fast when maybe they only have a fraction of the data are going to gain a competitive edge. But such talent is in short supply and companies need to be good at recognising and developing it.

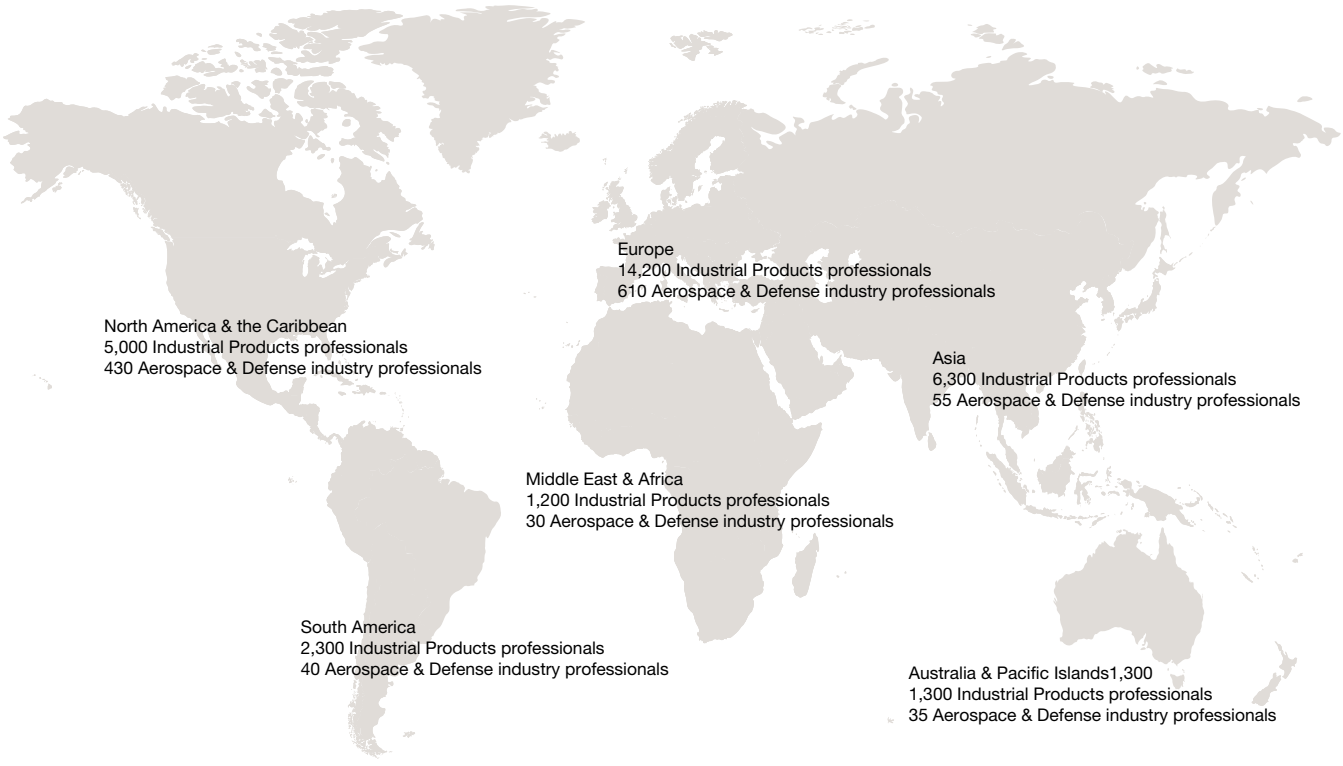
PwC aerospace and defence experience

Deep aerospace and defence experience

PwC's A&D practice is a global network of nearly 1,200 partners and client service professionals who provide industry-focused assurance, tax, and advisory services to leading A&D companies around the world. This A&D experience is enhanced by our Public Services practice, which includes an additional 600 partners and 9,000 professionals focused on assisting federal, state, and local governments, international agencies, and healthcare entities. We help A&D companies address the full spectrum of industry-specific challenges across areas such as assurance, tax, operational improvement, supply chain management, programme management effectiveness, IT effectiveness and security, compliance, export control, and government contracting. PwC's A&D client service professionals are committed—both individually and as a team—to the relentless pursuit of excellence, building insights, and advancing leadership on a wide range of the most critical challenges and issues confronting A&D organisations. PwC is a sponsor of leading industry conferences and frequently writes articles for, or is quoted in, leading industry publications. We are proud of our relationships with Aviation Week and Flight International as well as our participation in industry conferences and associations, such as the Aerospace Industries Association (AIA), AeroSpace, Defense, Security Group (A|D|S), and American Conference Institute (ACI). Our involvement in these organisations reflects our commitment to addressing industry needs and the furthering of dialogue with A&D industry leaders.

Local coverage, global connections

In addition to the 1,200 professionals who serve the A&D industry, our team is part of an extensive Industrial Products group that consists of more than 31,500 professionals, including approximately 18,600 providing assurance services, 7,700 providing tax services, and 5,200 providing advisory services. This expands our global footprint and enables us to concentrate efforts in bringing clients a greater depth of talent, resources, and experience in the most effective and timely way.



Contacts

PwC's global aerospace and defence practice

PwC's A&D practice provides industry-focused assurance, tax, and advisory services. Through our global network, we can draw upon the in-depth industry experience of professionals in every country where your company operates. Our people can help you deal with the challenges of today, and they understand the implications for tomorrow.

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We would like to thank the Chief Executive Officers and senior executives who took the time to share their viewpoints with our team.

We would like to express our appreciation for the expertise and support provided by the below listed individuals: Oren Ben-Zeev, Barry Berisford, Philippe Chervi, Frank Kathmann, Elizabeth Montgomery, Jeannette Chu, Keith Robinson, Guillaume Rochard and Scott Thompson. In addition, Partners and Directors of PwC's Global Aerospace & Defence industry practice conducted the executive interviews.

Thanks to Katrine Ellingsen for her role as A&D Insights programme director and to Frank Moniz for design and production.

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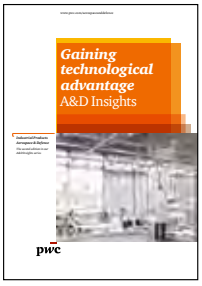

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 2748-02-6.22.2012