

**SPRING 2017
INDUSTRY STUDY**

**FINAL REPORT
*AIRCRAFT INDUSTRY***

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AIRCRAFT INDUSTRY STUDY 2017

ABSTRACT:

The 2017 Eisenhower School Aircraft Industry team analyzed the strategies of select aircraft firms in the United States and Europe over the last five years in an effort to assess in aggregate their implications for both the Department of Defense (DoD) and the overall national security of the United States. The team conducted research using a variety of methods, including a guest lecture series, visits to key domestic and international defense firms, and independent research. This study analyzed the strategies of the following firms: Boeing, Lockheed Martin, Northrop Grumman, Airbus, BAE Systems, Dassault, Leonardo, and Saab. The study also examined the different national frameworks within which the firms reside as well as China and Russia's aircraft industry structures. The group identified opportunities and challenges for these firms and characterized various government and firm interactions and the emerging implications for DoD and the U.S. government.

Seminar Members:

CDR Saud al-Maawali, Royal Air Force of Oman
Dr. James Baker, U.S. Marine Corps
Mr. Robert Craven, Department of the Air Force
COL Krzysztof Cur, Polish Air Force
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Mr. Daniel Kitts, Department of the Army
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Mr. Rick Teal, Defense Logistics Agency

Faculty Lead:

Dr. Sorin Lungu

INDUSTRY FIRM VISITS & GUEST LECTURES

Domestic:

Moog, Inc., Blacksburg, VA	OEM components, additive manufacturing
Boeing Defense, Space, & Security, St. Louis, MO	F/A-18E/F, EA-18F, F-15E, T-X
Boeing Vertical Lift, Ridley Park, PA Boeing Commercial Airplanes, Everett, WA	V-22, CH-47, FVL Commercial aviation market, missiles & tankers
Bell Helicopter, Amarillo, TX	V-22, UH-1Y, AH-1Z, Model 525, Future Vertical Lift
Lockheed Martin Aeronautics, Fort Worth, TX	F-35, F-22, F-16
DynCorp International, Fort Worth, TX	Maintenance, repair & overhaul (MRO)

International:

Swedish Security & Defense Industry Association (SOFF)	Structure-conduct-performance of the Swedish security & defense industry
Stockholm International Peace Research Institute (SIPRI)	Global defense industry dynamics & arms transfers
Saab Aeronautics, Linköping	JAS-39 Gripen, T-X Program
Ministry of Defense, Sweden (MOD)	Priorities of Swedish defense, research & acquisition policy
Swedish Defense Material Administration (FMV)	Organizational overview, arms exports, commercial strategies & procurement, MRO
Swedish Defense University, Stockholm	Future warfare, innovation & defense industrial dynamics in a Nordic, European, Transatlantic & global context

Guest Lectures

Richard Aboulafia	Vice President, Analysis, Teal Group Corporation
W. Alexander Vacca, PhD	Corporate Director, Business Analysis, Northrop Grumman Corporation
Brian Kough	Director of Forecasts & Analysis, Aviation Week Intelligence Network
James Hasik	Nonresident Senior Fellow for Defense, Brent Scowcroft Center on International Security, Atlantic Council
John Piasecki	CEO & President of Piasecki Aviation

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I. INTRODUCTION

This report examines the influence that government policy choices have on firm behavior in the aerospace and defense (A&D) sector, from the perspective of the firms themselves. The research team focused on the fighter aircraft market and observed that the internationalization and globalization that first transformed non-defense commercial markets decades ago markedly affected the A&D sector later, with an accelerating impact from the end of the Cold War. Globalization's transformative effects arrived "late" to the sector because of its insulated situation, in which governments were monopsonistic consumers that sought to sustain high degrees of autarkic self-sufficiency. Governments were traditionally prepared to pay a "sovereignty price" to maintain key capabilities within their borders, which might otherwise have been acquired more affordably through trade. Declining defense budgets, at the same time that the complexity of fighter aircraft increased sharply, drove up per-unit costs and drove down the sector's output, putting intense pressure on existing national A&D sector models.

The more modest the scale of a state, with correspondingly smaller budgets and more shallow markets, the earlier the state faced stark defense industrial base (DIB) choices. Following the fall of the Soviet Union, states progressively recognized that domestic demand would be insufficient to sustain competitive DIBs in the A&D sector. These states had available three general policy responses. They could exit the sector altogether, retain a role through producing components or engaging in teaming to produce aircraft, or seek to expand their exports as well as reliance on foreign components to keep A&D firms viable despite weak domestic demand. The years between 1990 and 2017 tell the stories of these different approaches. The UK in effect exited fighter-production. Italy similarly sought to remain a player through collaborative teaming, component manufacturing, and maintenance, repair, and overhaul work (MRO). Sweden and France clung onto the ability to produce fighters "nose to tail," using different strategies. In the United States, as was the case in the other national markets, firms were subject to rapid consolidation. Meanwhile, Russia and China, both states steeped in the lingering impulses of command economics, through different policies strove to defy the pressures of globalization.

These pressures toward the internationalization of the A&D sector and the increasing importance of exports, trade, and integration are likely to persist. It seems unlikely that even the United States, despite its large defense budget, requirements, and market, can sustain a competitive DIB organized primarily around domestic demand, assuming other factors remain constant. If this is valid, then the international arms sales market presents a new strategic competition space that will determine the viability and competitiveness of a nation's DIB more so than in the past. There may be government policy options that could be used to exploit this emerging area of competition. If the security situation worsens (as in case of Ukraine, which increased demand for arms in Europe) and technological trends continue (with a need for both high-cost platforms and low-barrier-to-entry cyber capabilities), states with firms that possess the capacity to develop and produce arms with global markets as priority rather than as an afterthought will benefit at the expense of others less able to adapt to the changing context. It has been our observation that the firms in the A&D sector are more sensitive to changes in this market than governments have been, and that cooperation between governments and firms in foreign markets represents the most competitive teaming. Foremost is the need for governments to recognize consciously the overall climate their choice of policy options creates.

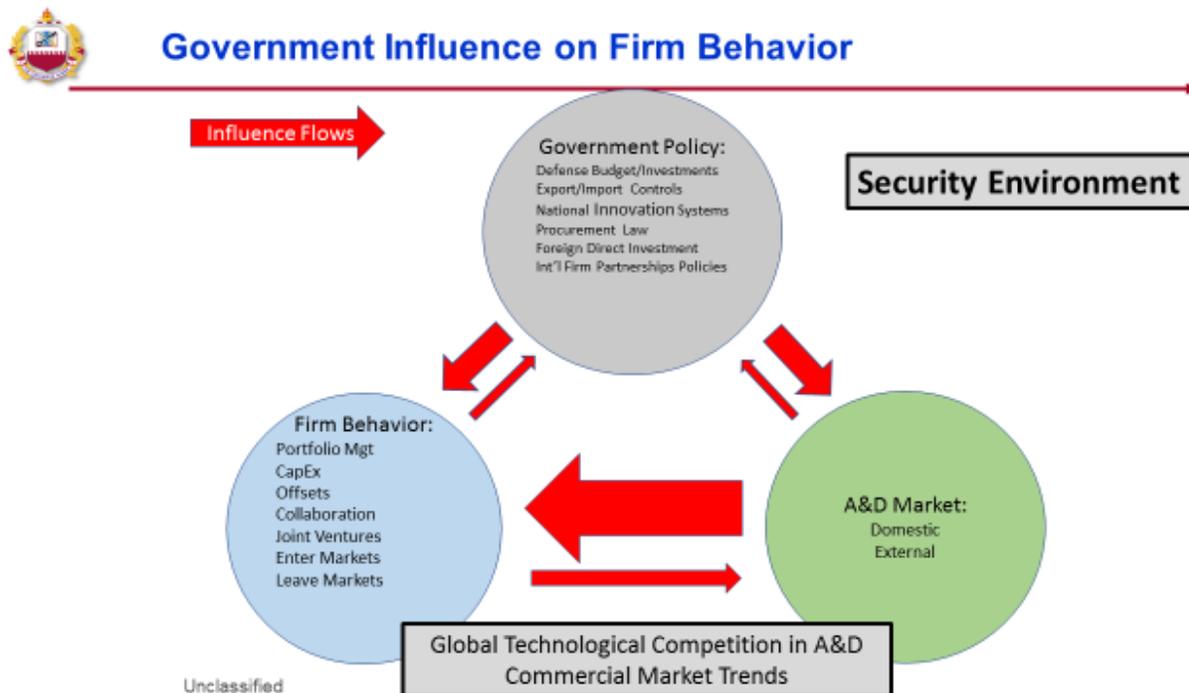
RESEARCH METHODOLOGY AND LIMITATIONS

The team conducted research from January to May 2017 based on a review and analysis of open-source data, reports, and studies from government, academic, industry, and news media sources. Guest lecturers and non-proprietary corporate reports, as well as research team visits to aerospace industry firms in the United States and Europe provided industry perspectives. This report is unclassified and is based exclusively on unclassified sources, to include all lectures, interviews, and documentary information.

DISCLAIMER

The views expressed in this paper are those of the research team (students and faculty) and do not reflect the official policy or position of the National Defense University, the DoD, or the U.S. government

II. THE INTERACTION BETWEEN GOVERNMENT POLICY AND FIRM BEHAVIOR



This chart is designed to show the relationship between externalities, government policy, the market, and firm behavior. The arrows are intended to show the relative flows of influence between these factors.

Externalities: Externalities exist outside the control of a particular government or entity. These include:

The Security Environment: This includes examples such as the fall of the Soviet Union, or the more recent expansion of China into the South China Sea, or Russia assertiveness in Ukraine. These changes will influence governments to either increase or decrease defense budgets.

Global, Technological Competition in A&D: This captures the pressure that technological advancements place on governments, firms, and markets. Examples include new air defenses, stealth, and AIP submarines.

Commercial Market Trends: The A&D sector often lags what has happened in global commercial markets. Examples include global supply chains, outsourced manufacturing, global capital flows, and the import of finished products. It also includes modern business management and organizational theory.

Government Policy Levers: Governments have a number of 'levers' that they can pull to secure their interests. These include:

Defense Budget/Investments: Government spending on defense related items and investments in innovation related to national defense.

Export/Import Controls: These are controls that governments place on what technologies can be exported to other countries. In the United States, the Defense Technology Security Administration (DTSA) sets

controls on what high-technology items can be exported. There are also restrictions on what items may be imported. Some governments may demand that certain items are sourced domestically; examples in the United States are the Berry Amendments and other “buy American” measures.

Innovation System: Governments can act to foster a national innovation system (NIS). They can do this by spending money and structuring relationships between academic institutions, national labs, and government research and development (R&D) offices.

Procurement Law: Governments set policy on the types of acquisition programs, platform requirements, and the frequency of programs. Excessive procurement regulations and oversight have been criticized as slowing the development and fielding of new systems.

Foreign Direct Investment Policy: Governments may either foster or hinder the ability of foreign firms or governments to invest or buy specific firms in a country.

International Firm Partnership Policies: Governments can promote or disallow firms to partner with companies outside of the country on defense projects.

Security Assistance: Governments can choose to help other countries across the spectrum of capabilities, such as with health, domestic security, institutions, and other avenues beyond strictly the sale of military hardware.

Firm Behaviors: Firms have many choices in approaching the markets they compete in, the government oversight they are subjected to, and their perceived competitive advantages. These include the following among many other choices:

Portfolio Management:

Firms have four general choices for future strategies with respect to portfolio management:

- Maintain – Adhere to existing strategies;
- Expand Market – Seek to increase market share;
- New Market – Enter a new market; and
- Exit Market – Leave the current market

Mergers & Acquisitions: Merge or purchase other firms.

Supply Chain Management: Take a different or more aggressive approach to managing supply chains.

R&D: Use firm resources to engage in independent R&D.

Maintenance, Repair, & Overhaul: Expand into the long-term MRO market.

Foreign Military Sales: Encourage the host government to sell a firm’s hardware to another country.

Direct Commercial Sales: Sell hardware directly to another country outside of FMS, ideally with the host government’s full support.

In the chart shown above, firm behavior is influenced by the market more than anything else. The relative size of the arrows suggests that the government influences the firms more than the firms influence the government. This specific chart is different for each country and changes over time. In Italy, for example, the government owns 30 percent of Leonardo, while in Britain the government retains “golden shares” that permit the exercise of control over certain firm decisions, so the influence these governments

have on what are in effect national champions is even more direct than the influence the U.S. government has on U.S. firms. Firms also influence the market. They may introduce new products that create a market that did not previously exist. In turn, the market can influence the government. In many areas, the market has introduced technologies and behaviors that have forced governments into reactive postures. There is also a flow of influence from firms to the government. For instance, a firm may petition the government to allow it to export products without the hindrance of excessive export restrictions. Firms also communicate to their host governments what they need to remain competitive.

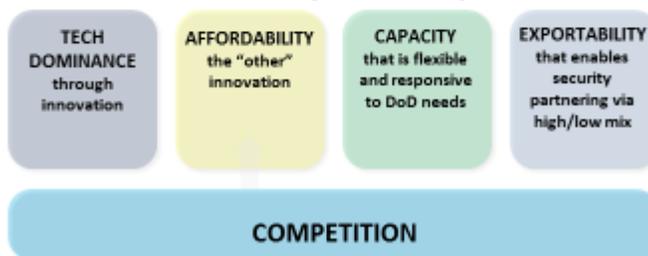
The relationship between governments and firms in the context of competitive market forces creates a dynamic series of core needs that drive expectations and policy. These core needs center on four specific areas: technical dominance through innovation, affordability, capacity, and exportability. The interplay of these core characteristics ideally enable a DIB, whether judged on a national basis or on a regional or even global basis, to sustain innovation with flexible responses to defense market needs. Competition facilitates innovation and increases return on investment. We will take up this overall topic once again after surveying the regional Euro-Atlantic fighter market, the experiences of Russia and China, developments in key European markets, and the strategic business approaches of the firms the research team examined over the course of the study.



Government Priorities

- Sustained Competitive Advantage
- Technical Dominance of Military Capabilities
- Cost Effective and Timely
- Security of Technology and Reduction of Diffusion
- Competition Amongst Major Firms
- Supply Chain Security
- Surge Capacity
- Sustainment & MRO

Core needs from industry:



Unclassified

1

III. EURO-ATLANTIC FIGHTER MARKET DYNAMICS

For purposes of this paper, the definition of fighter aircraft excludes trainers or light-ground attack jets, such as the Aero L-39 Albatross, Alenia Aermacchi M-346, BAE Hawk, and the Textron AirLand Scorpion. Such aircraft may be armed with air-to-air missiles and guns, but do not represent full-spectrum, modern military aircraft designed to achieve air superiority and confront operators of fourth or fifth generation fighter aircraft. The North American Industry Code System (NAICS) code that encompasses this market, 336411, is a broad category that including the overall “aircraft manufacturing” industry in a comprehensive sense.¹

Current participants in the market include the remaining U.S. producers of military aircraft (Lockheed Martin, Boeing, and Northrop Grumman). European firms that compete in the market are Dassault Aviation, Eurofighter (Airbus/Leonardo/BAE Systems), and Saab. Although the Euro-Atlantic fighter market is dominated by these Western participants, the legacy of former Eastern Bloc countries’ participation in the Warsaw Pact and/or operation of Soviet equipment means that residual use of Russian airframes persists, although only Serbia has chosen to acquire further Russian-supplied equipment to refresh existing inventory.² Overall, however, the Euro-Atlantic fighter market is bound together well through the widespread, long-term use of fourth-generation platforms produced by U.S., French, Swedish, and joint efforts undertaken by Britain, Germany, and Italy, sometimes together with Spain. These platforms will soon be joined by significant numbers of the F-35, the first fifth-generation platform in widespread use.³

A COMPETITIVE OLIGOPOLY RACING TOWARD RESTRUCTURING

On its face, the market appears competitive, with many examples of current and former requests for proposal attracting submissions from a number of the six contenders, as two examples below illustrate. These have included competition between Lockheed Martin, Boeing, and Eurofighter to replace Denmark’s F-16 fleet.⁴ Procurement competitions on the horizon in 2017 and 2018 for Switzerland and Belgium are both likely to attract interest from most if not all of Dassault, Eurofighter, Lockheed Martin, and Saab.⁵ In North America, both Lockheed Martin and Dassault have positioned themselves to compete to provide an aircraft to replace Canada’s aging CF-18s, while Boeing appears on the verge of winning a stop-gap Canadian procurement of F/A-18 Super Hornets in an effort by Ottawa to fill operational requirements.⁶ This will buy time for the Canadians to undertake a deliberate acquisition process while they observe the pace at which F-35 production achieves economies of scale.⁷

A closer examination, however, reveals that the market is already highly concentrated and likely to become more so. Measured by either value of production or number of units projected for 2017-2021, the results are arresting.⁸ Herfindalh-Hirshman Indices (HHI) calculated for these two approaches total 3,932 and 4,126, respectively, indicating a highly concentrated industry.⁹ The simpler approach of summing the market share commanded by the four largest firms by value of production and number of units projected results in market concentrations of 91 and 95 percent, respectively. The market, although therefore an oligopoly at present, could be described as one in which there had been until recently pockets of intense competition as noted above.¹⁰ It is likely, however, that the accuracy of that assessment will soon wane, revealing that although such an oligopoly existed for fourth-generation fighters in the period from 1980 to the 2000s, it is now set to fade in the decade ahead as a shift is made to fifth-generation technology.¹¹

MARKET STRUCTURE

The modern fighter aircraft market as it is currently structured is on a trajectory toward market failure in the long term. A brief examination of its structure through the lens of four of Porter’s five forces proves revealing.¹²

There are high barriers to new entrants in the market. Defense markets have long been segmented by government efforts to preserve national champions for both political and economic reasons as well as concerns with maintaining a DIB within individual countries.¹³ To capture these benefits, states are willing to pay a sovereignty price or premium beyond what would otherwise be the market cost.¹⁴ This has played out in many ways, with many countries working to avoid or declining to use foreign-produced equipment (the United States is a prime example, having generally used only U.S.-origin weapons, with a few notable exceptions such as the Harrier jump jet). One clear manifestation of the depth of nationalism as a force in defense acquisition is the lack of a common European defense market, despite 68 years of NATO collaboration and 60 years of European Union efforts to create a common market in goods and services.¹⁵

In addition, the increasingly complex technologies involved in defense aerospace mean that the capital required to develop and commercialize cutting-edge products has soared.¹⁶ At the same time that costs per unit have leapt, most states in the Euro-Atlantic community have deeply cut their defense expenditures as a percent of GDP in the years since the Soviet Union dissolved. Most NATO member states routinely fail to meet the alliance's goal of devoting two-percent of GDP to defense spending.¹⁷ This has translated over the last 30 years to a steep decrease in airframe procurement, putting further pressure on producers and reinforcing the steep increase in unit costs.¹⁸ New market entrants are hard pressed to overcome national acquisition biases, raise very large amounts of capital (although it is perhaps possible with government assistance), all to produce an expensive, low-volume product that requires a decade or more to develop.

Substitute products in defense aerospace for now appear implausible. There are no obvious one-to-one substitutes available for fighter aircraft. Drones have not advanced yet to the stage that they are able to operate in adverse combat environments.¹⁹ Moreover, it is not clear that an unmanned, fully-capable fighter would be significantly less costly than manned aircraft in all cases and for all applications.²⁰ Alternative weapons, like ground-based air defense systems, might provide some of the same defensive effects that fighters do, but have no ability to project power. Missile forces and some drones might also be able to provide some of the offensive effects of fighters, but no weapon system now in use could cover the range of mobile offensive and defensive capabilities that fighter aircraft offer.

Buyers have significant bargaining power to affect price. The pool of fighter aircraft customers is limited to sovereign states, only some of which have the resources to purchase air assets at the level of fourth- and fifth-generation fighters. Offsets are proof of states' price making influence.²¹ Sovereigns, moreover, are not only customers, but also regulators, who by their nature are in the position of having the legal upper-hand over suppliers operating in their territory. This is tempered by governments' need to provide for their populations' defense and the sorts of nationalist purchasing biases that are seen in the United States and France, which limit competition. While sovereigns are not complete monopsonistic price makers, the combination of their legal power, taken together with the limited competition that exists in the market now, positions them to have a strong influence on price.²²

Suppliers have alternatives. Defense aerospace suppliers have less control over price than governments do, but are also not price takers *per se*. The intricacies of working in the defense industry – particularly in the United States and certainly elsewhere as well – means that to work in the defense aerospace sector requires a familiarity with the same array of policy, practice, and accounting requirements that systems integrators/prime contractors face. This creates a barrier to entry for suppliers, many of which at the same time have the alternative of supplying the less fraught civilian aerospace market. The broad technological complexity of military aircraft also means that many suppliers also have the alternative of repositioning to compete in not only other defense industries, but also in a wide variety of non-defense manufacturing and software industries, giving them exit opportunities.²³

MARKET FAILURE – AND FRAGMENTATION?

While defense markets have long been distorted by nationalist approaches to production and acquisition, it appears that low defense budgets, the increased technological complexity of fighter aircraft that is driving soaring research and development costs, and the resulting low-scale production of platforms is not only preventing new entrants into the market, it also clearly has the potential to drive established producers out of the market.

What is relevant now is that the market is rapidly approaching what appears to be a fundamental shift with the advent of hyper-expensive fifth-generation fighters and the unmanned platforms that will follow them. Individual countries like France and Sweden have struggled to sustain national champions and even joint efforts are reaching the stage at which European defense budgets are insufficient to support R&D costs in light of relatively low production runs.²⁴ Advanced fourth-generation platforms are already so expensive that marketing them in large numbers to states outside the Euro-Atlantic market has yielded few sales for the Eurofighter, Rafale, and Gripen.²⁵

Sales of fourth-generation Euro-Atlantic fighters are so anemic that most, if not all, of the production lines face the prospect of closure or very low production at best in the next decade.²⁶ At the same time, Lockheed Martin is the only Euro-Atlantic producer currently working to develop or produce a fifth-generation platform. Without another Western firm or consortium ready to enter the fifth-generation fighter market, Euro-Atlantic states that require state-of-the-art fighters may soon have no realistic alternative to the F-35. These customers would be unwise to turn to products theoretically available from potential adversaries (Russia and China) and are unlikely to see products in development by other states (Japan, Turkey, and India) come online soon, if ever.²⁷

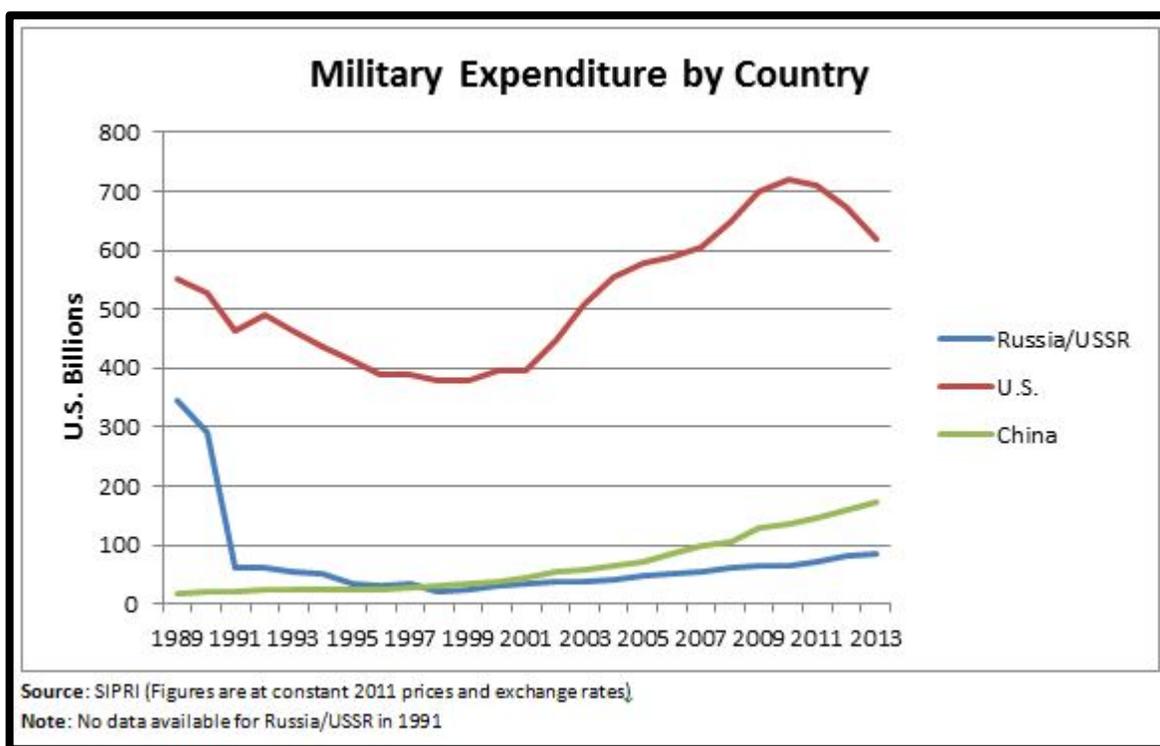
As Lockheed Martin F-35 production increases in scale, development issues are resolved, and per-unit price falls, the airframe's reportedly clear superiority to fourth-generation fighters could well expose fourth-generation alternatives as expensive as well as largely obsolete, although they may serve usefully in concert with fifth-generation assets.²⁸ A transitional phase may ensue during which some Euro-Atlantic states such as Bulgaria, Canada, Finland, Slovakia, and Switzerland acquire further and more advanced fourth-generation fighters, trading capability for lower cost.²⁹ This may make it appear as though the Euro-Atlantic fighter market has fragmented into two distinct markets – one for fifth- and another for four-generation platforms, which are not genuinely comparable products, even though their use together in a mixed force may be effective. Euro-Atlantic states are only likely to face Russia, or in the case of the United States, China, as genuine adversaries. This has the effect of limiting the long-term combat utility of fourth-generation platforms, which might need to face those two states' most advanced aerospace products. Some Euro-Atlantic states may nonetheless choose to acquire fourth-generation aircraft, but such choices are more likely to be made for symbolic defense or economic reasons apart from pure military effectiveness.

Export purchases of fourth-generation fighters may prolong this transitional phase, but as fourth-generation technology is mastered by outside competitors – in part as a result of co-production and licensing arising from offsets – the market viability of Euro-Atlantic products outside Europe will decrease. This should cut into orders, reinforcing pressure on whichever fourth-generation production lines survive into the next decade. In the meantime, Russia and China have attempted to create and cope with their own market dynamics.

IV. RUSSIAN AND CHINESE FIGHTER MARKET DYNAMICS

State elites face the challenge of striking a balance between the disruptive yet value-generating capacity of a market economy and the state's ability to exert control over this activity for the preservation of the regime and the state itself. Cognizant of this fact, the modern Chinese and Russian states manipulate the structure of their individual DIBs while attempting to maintain state control over the resulting economic activity. These two nations selected A&D firms as national champions for two reasons, to act as incubators for their NIS, and to deliver arms for the national defense and pursuit of power in military contests. They have confronted the dilemma between fostering innovation and maintaining centralized control by underwriting A&D activity at the risk of distorting the more efficient allocation of capital through free market activity. Absent this command influence, they fear, the pursuit of private wealth will erode state control.

Today the Russians and the Chinese confront two distinct challenges with respect to their DIBs. In Russia, the goal becomes preserving and sustaining the innovative and competent DIB that produced some of the world's most advanced military hardware in spite of drastic cuts in defense spending following the fall of the Soviet Union, and because of Russia's current economic woes. China faces an altogether different challenge: developing, almost from scratch, a DIB capable of producing arms that can compete with products from the United States, Europe, and Russia. Structurally, then, the question becomes one of how these states manage the relationship between the government and the DIB in an attempt to optimize sustainable outcomes without damaging the rest of the economy.



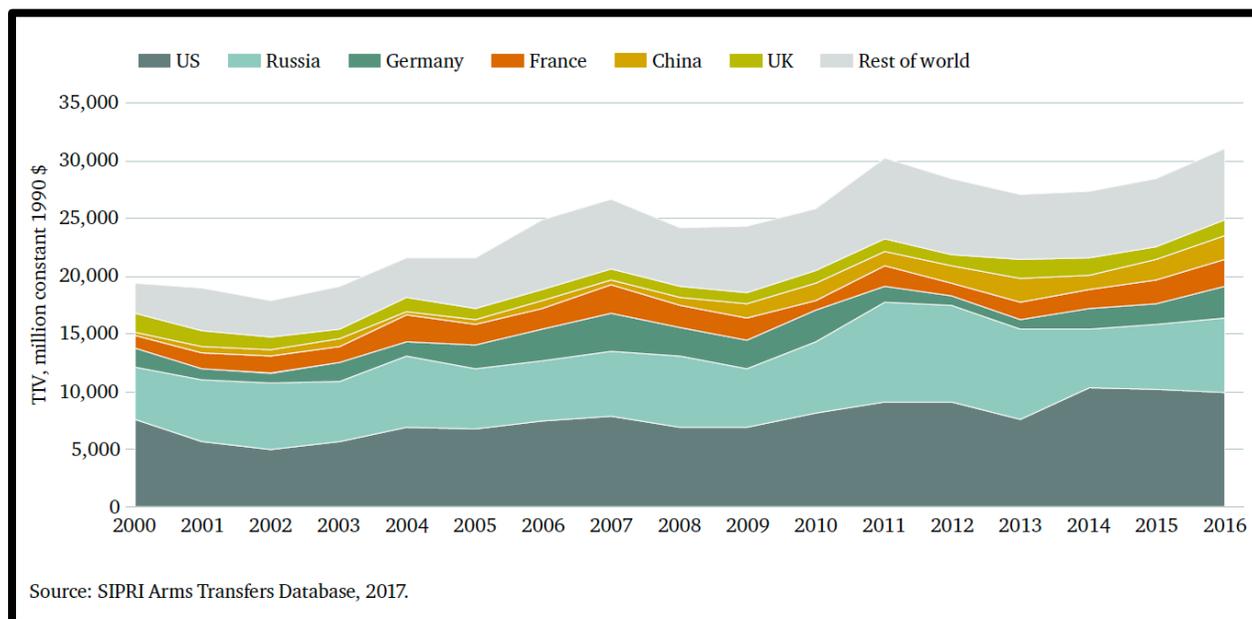
THE RUSSIAN DIB

Prior to its collapse, the Soviet Union could boast about the sophistication of its weapons systems across all domains of military competition. A technically competent DIB and NIS produced the world's most advanced air defense systems and nuclear delivery platforms. In the ten years between 1988 and 1998, defense spending in the Soviet Union/Russia fell from \$250B to \$14B.³⁰ This sector was left largely unfunded during the decade after the collapse of the Soviet Union, until the point at which defense

spending started to increase in 1999. The challenge for Russia has been to keep this heritage of innovation and production alive despite reduced funding and domestic demand for its products.

In 2016, defense industrial production is one of only a few technology intensive economic sectors in which Russia can be considered a world leader.³¹ President Vladimir Putin recently affirmed the potential of defense industrial activity to “serve as fuel to feed the engines of modernization in Russia’s economy.”³² However, there has not always been sufficient domestic demand to keep these engines running. In the 1990s, when defense procurement was drastically reduced, arms exports kept many enterprises afloat.³³ The defense industry is also important socially, as it accounts for a significant share of employment in Russia. With approximately 2.5 million workers, Russia is responsible for more than three percent of total employment, and nearly one-third of employment in manufacturing, with defense-industrial R&D and production occupying a dominant place in many cities and regions.³⁴

Arms exports perform political functions as well. Historically, by supporting the formation of linkages with politically aligned states, the Soviet Union used arms sales to expand its spheres of influence and create a more favorable political and strategic situation.³⁵ That practice continues through today. In 2013, the deputy prime minister for the defense industry, Dmitry Rogozin, stated in even bolder terms that the Federal Service for Military-Technical Cooperation – the agency leading arms sales abroad – was “the country’s second foreign policy agency” and that its objective in selling arms was so Russia could “gain or increase its influence in other countries.”³⁶ These sales help support defense-industrial production in areas where domestic demand may be insufficient to maintain production lines. This helps preserve a wider spectrum of production capabilities than might otherwise be possible, as was the case during the 1990s. Exports can also be profitable for producers because government spending may contribute towards development costs of dual use, civil-military, programs.³⁷



World Arms exporters, 2000 to 2016

Russia’s 2006 re-nationalization of its aerospace industry heralded a new era in industrial policy. Symbolizing a return to the importance of securing sovereignty over the Federation’s strategic assets, it also posits powerfully that sectors like aerospace and shipbuilding are too important to be left to the market.³⁸ In what now appears a reversal of this policy approach Moscow is promoting partial privatization and encouraging partnerships with Western aerospace companies. Foreign infusion of capital

and technology is viewed as the catalyst for Russian dominance in the global military and commercial aerospace industries.³⁹ The majority of Russia's manned air systems design, development, manufacturing, leasing and support services companies have been consolidated under the United Aircraft Corporation (UAC) holding company: a state-controlled organization created in 2006 by presidential decree. Russia has enjoyed virtual self-sufficiency in the manned air systems domain, although a number of deficiencies remain.⁴⁰

Russia remains committed to the centralized, state-controlled DIB market structure it adopted beginning with the consolidation of the Sukhoi and MiG aircraft firms. The state initially owned a 75 percent stake in UAC, subsequently rising to 81.75 percent, while the national development bank (VEB) and private investors held 10.60 percent and 7.64 percent, respectively.⁴¹ The desire to retain political control was evident from the composition of the UAC Board of Directors.⁴² Among the 14 members were the Deputy Prime Minister, the Chairman of the government-owned Bank for Development and Foreign Economic Affairs, the Commander-in-Chief of the Air Force and the Deputy Ministers of Economic Development, Industry and Trade, Finance, and Transport. These appointments clearly represented a desire to bring and maintain the industry under the political control of the central government.⁴³ Among the deficiencies that hobble the Russian A&D Sector is low productivity, which is estimated to be ten times lower than that of their counterparts in the United States and Europe. In 2009, UAC revenue per employee was US \$39,000 while that of Boeing reached US \$216,400.⁴⁴ Serious challenges are still causing losses in various plants. The most evident of which are underutilized production capacity, old technologies and high cost of components. Compounding this is the fact that UAC faces a lack of skilled personnel.⁴⁵ Corruption is also a factor. The consequence of corruption is an estimated 20 percent to 40 percent of procurement funding was lost as a result of poor practices.

Perhaps the most significant, long-term problem for the Russians, however, is the depressed oil market. Prices below \$50 dollars per barrel thwart Russia's long-term modernization and recapitalization effort because oil revenue is so central to the Russian government's finances. The 2008 war with Georgia had acted to spur an expansive modernization program in Russia. Russia's economy however, slowed by persistently low oil prices and targeted sanctions, has been unable to support the full goals of the modernization effort. The 2010 State Armament Program (SAP) set the ambitious target of 600 aircraft and 900 helicopters for delivery by 2020. The program remained largely on target, with four hundred new-build aircraft entering service, with 200 of them being front line fixed-wing airframes.⁴⁶ The collapse in oil prices and economic repercussions of Moscow's intervention in Ukraine in 2014 (including the annexation of Crimea), however, vastly altered the geo-strategic, economic and fiscal conditions in Russia, putting an end to this period of rapid, sustained growth.⁴⁷ The target date for completion of the balance of this initiative has slipped to 2025 as a result. It may slip further if oil prices remain low.

These factors create a tension that government must address. Nonetheless, in spite of headwinds, the full-spectrum capability of the Russian DIB reflects persistent strength, which despite more than a decade of chronic underfunding after 1990 remains able to produce large volumes of robust and capable equipment.⁴⁸ Russia remains especially strong in complex weapons, including manned aircraft. It has the ability to design and produce advanced military and commercial engines, a skill China does not possess. What Russia lacks is demand for these products. Key to the survival of Russia's DIB since 1990 has been the export of these advanced weapons systems. Exports are not as important to the Russian defense-industrial complex as they were in the 1990s, but continue to help keep production lines in service, and thus help preserve the full spectrum of defense-industrial production capabilities.⁴⁹ If the scheduled reduction in spending is indeed sustained, international arms sales would help offset reduced domestic demand.⁵⁰

THE CHINESE DIB

China has enjoyed rapid growth in exports since economic reforms began in 1978, which have contributed to the country's overall economic growth. Improvements in the quality of China's workforce, manufacturing technologies, and materials enabled the country to enter new, more technologically sophisticated industries.⁵¹ The Chinese government denoted several industries and employed industrial

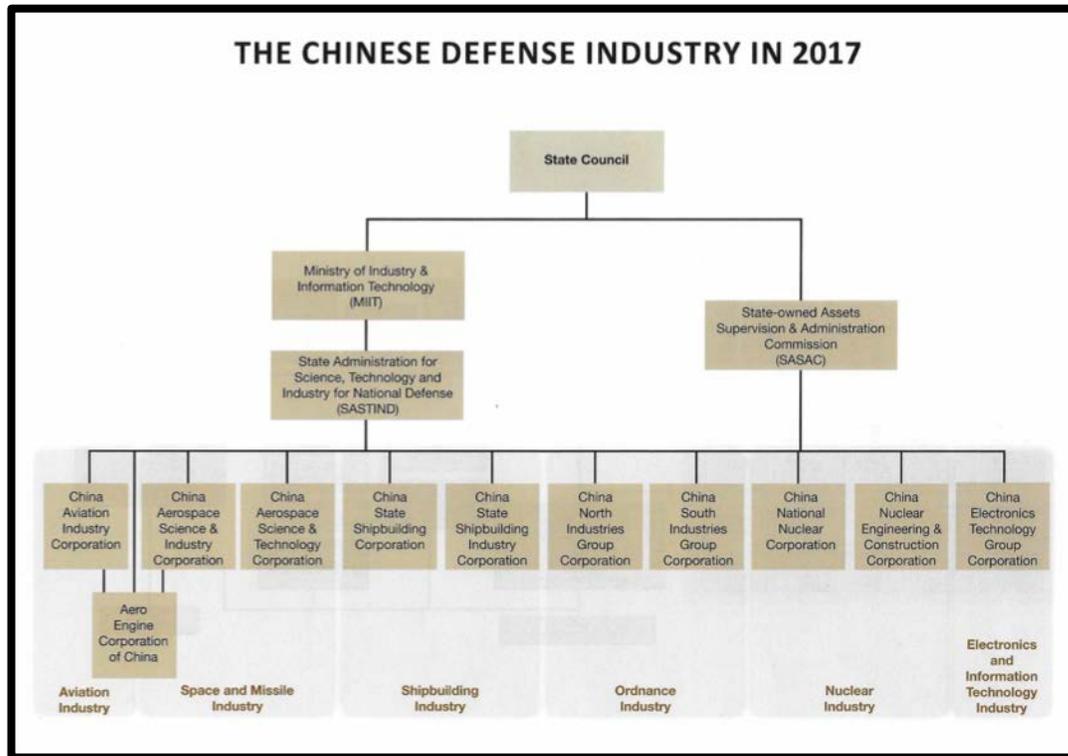
policies, formal and informal, to foster the development of national champions. As part of this strategy, the Chinese government attempted to induce the transfer of technologies from foreign manufacturers to Chinese companies. To the extent that these policies have been successful, they have accelerated shifts in production and employment from industries located in other countries to China.⁵² China has attempted to transfer these commercial sector advancements to their DIB, however China's A&D industry's maturation has proven to be both a facilitator and inhibitor to its military modernization program and national development.

Between the 1960s and 1990s, the Chinese airpower establishment was mired in prolonged stagnation. The most serious problems included a severe lack of investment in research and development, an absence of high-level leadership interest and support, a broken innovation eco-system, and a trapped legacy of dependence on obsolete Soviet-derived technologies.⁵³ In autocratic states, proximity and access to the ruling elites is key to programmatic success. Following the performance of the U.S. and Western allies in the Gulf War in 1991, China realized that a manpower-focused military was relatively useless versus high-technology forces capable of delivering precision fires at range and volume. This realization led to a new emphasis from the highest levels of the Chinese Communist Party (CCP) on the A&D sector, and the airpower establishment's voice is increasingly being heard at the highest levels of authority.⁵⁴

Since this transition in 1990, Chinese leaders stressed the strategic employment of airpower for offensive and defensive missions. From a technological, industrial, and innovation perspective, the Chinese aerospace industry is making major advances and could join the top elite of full spectrum global air and space powers if this momentum is sustained over the next ten to twenty years.⁵⁵ Key factors include the role played by high-level leadership support, the influence of the threat environment, the far-reaching changes enabled by access to growing levels of resource allocations and foreign technology transfers, and the impact of reforms on the research and development apparatus, major defense corporations, and the organizational management of the armament development apparatus.⁵⁶

China's desire for a self-sustaining DIB, one capable of developing systems that are capable of keeping pace with Russia's and the West's most advanced hardware, has both a strategic and pragmatic objective: China seeks self-sufficiency at a strategic level— to support the military modernization effort, foreign policy and broader national development-- but is pursuing a pragmatic approach to getting there, primarily through the acquisition of foreign technologies that can subsequently be adapted, adopted, and integrated into capabilities with Chinese characteristics.

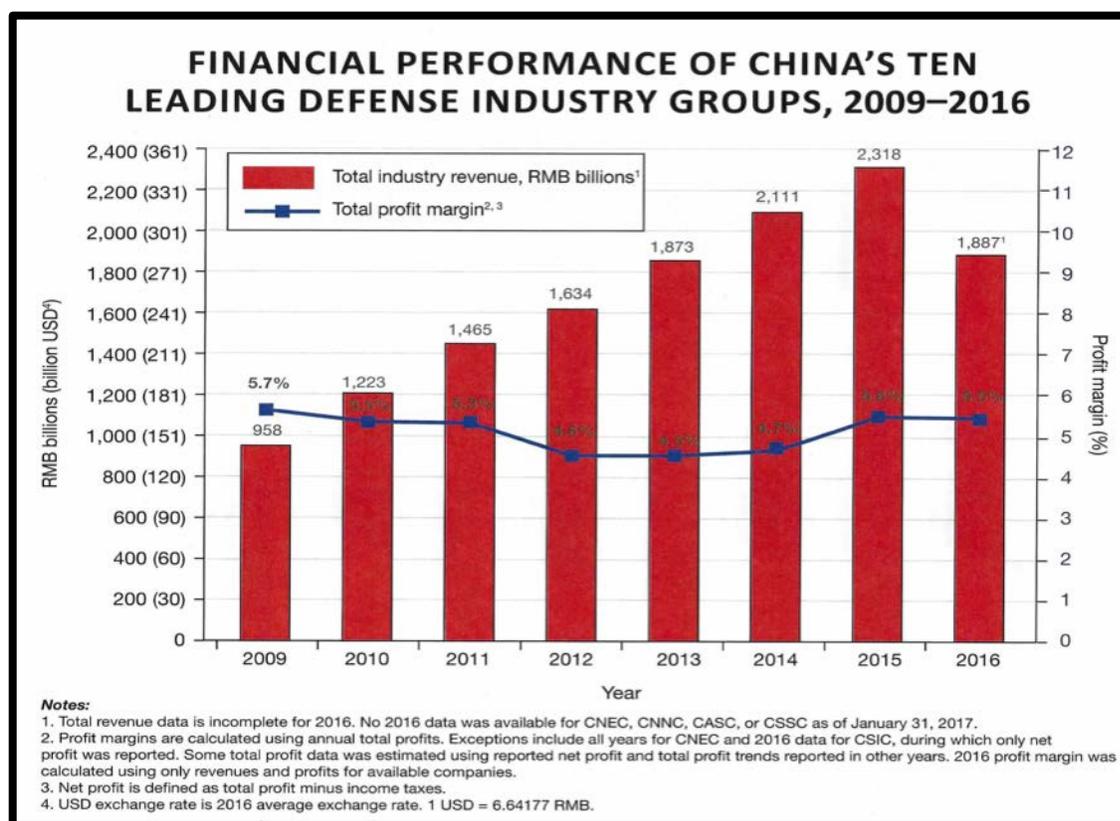
China's most recent move has been to copy the organizational structures that have proven successful elsewhere. China has looked to Japan as a model for the development of the techno-nationalist state, while remaining cognizant of its shortfalls and addressing them explicitly.



*The Structure of the Chinese Defense Industry*⁵⁷

The Europeans also serve as a model because they are the ones that caught up to the U.S. in the A&D sector. They challenged the monopolists and were successful in the large commercial aircraft market, and remain viable competitors in fighters and military transports. France, in particular, has had success maintaining “strategic autonomy” in their DIB. France is the remaining continental European state that can produce a complete modern fighter, nuclear weapons, and high-end business jets. EADS represents one of the few firms outside of the U.S. that can absorb long projects and the risk associated with technically complex systems.

China has attempted to emulate Western structures with AVIC, which may be labeled a Western DIB firm with Chinese characteristics. As China’s largest aviation industrial group, AVIC has been on a new path of reforms since November 2008 when the Chinese government re-merged twin aircraft manufacturers AVIC I and AVIC II after a decade of separate operations. The principal aim of having separate companies was to foster competition among firms in a domestic industrial base. Unfortunately for China, what developed were a series of inefficiencies associated with duplication of effort, wasted investments, and the opportunity for corruption to flourish. The principal aim of the 2008 re-merger was to move from traditional geographical divisions and consolidate overlapping areas of responsibility that limited the industry’s capacity for innovation and technological development. The transformation of AVIC created a new corporate structure and strategy designed to enhance China’s aerospace competitiveness and improve systemic efficiency. Particularly targeted is the delivery of equipment for the People’s Liberation Army (PLA) by integrating product lines, instituting best business practices, resource allocation, and accelerating industrial R&D innovation and production capabilities – in both civil and military aviation sectors.⁵⁸ Once trapped in static, duplicative imitation, China’s manufacturers now produce items showing creative adaptations and approach architectural forms of innovation, however the lack of competition among rival firms may remain a liability.⁵⁹



Financial Performance of China's Ten Leading Defense Industry Groups, 2009-2016⁶⁰

China is also interested in technology protection. Complex systems engineering and indigenous technological innovation remain challenges for China's industry and are inhibiting its ability to solve the most pressing technological issues (i.e., aero-engines), placing a growing premium on efficiency and acquiring technologies. To date, China has been successful in closing the gap in many areas, to include 4th generation fighters, Air Defense Destroyers, and surface to air missiles. The remaining question is if China is capable of closing the gap in other areas that have proven difficult for them, such as aero-engines and advanced avionics integration, and more importantly, if they can demonstrate creative innovation and push the capability of their systems past those developed in Russia and the West. However, despite having made advances in several areas over recent years, China's defense industry continues to import those weapons systems and components that it is unable to produce. Between 2000 and 2016, China accounted for 8.1 per cent of global arms purchases recorded by SIPRI, second only to India, with Russia supplying nearly 80 percent of this.⁶¹ The close relationship in the realm of armaments is part of an increasingly close political relationship between Russia and China.⁶² An important component of this approach is the development of commercial aviation as part of their A&D.

In terms of analogy, AVIC in China in 2017 represents the NASA in the U.S. in the 1960s; completely dependent on government support but justified as a technical incubator and on the hope that it will be capable of delivering future innovation and national prestige. In the U.S., NASA's Apollo-era budgets were not sustainable, and its products did not transition to a self-sustaining commercial market. As a result, it's the expectations for the agency, along with a willingness to fund it, have withered. The long-term viability of AVIC and other A&D firms that are currently government-sponsored will be determined by their ability to transition to competition in markets. Since the sector was largely consolidated by the state in 2006, the export market remains the only viable outlet for products that will free these firms from relying exclusively on outlays from the CCP. Accordingly, China's exports of major arms grew by 88 percent between 2006–10 and 2011–15, while China's share of the global volume of

arms exports rose from 3.6 to 5.9 percent between those periods, putting the country on a similar footing in terms of global share as France and Germany. China supplied major arms to 37 states in 2011–15.⁶³

In spite of improving circumstances, it remains to be seen if these factors are sufficient to set China's defense aviation industry on a course to become a global top-tier "critical innovator" comparable to the United States. Yet, with the accelerating development, qualitative orientation, and sustained resource allocations, China's manufacturers are at least poised to overcome structural and technological deficiencies and in the long run have a shot at joining a small circle of global leaders.⁶⁴ Additionally, the CCP is committed to the long-term success of its DIB, and has demonstrated a willingness to prioritize this success through demonstrations of funding and political favor.

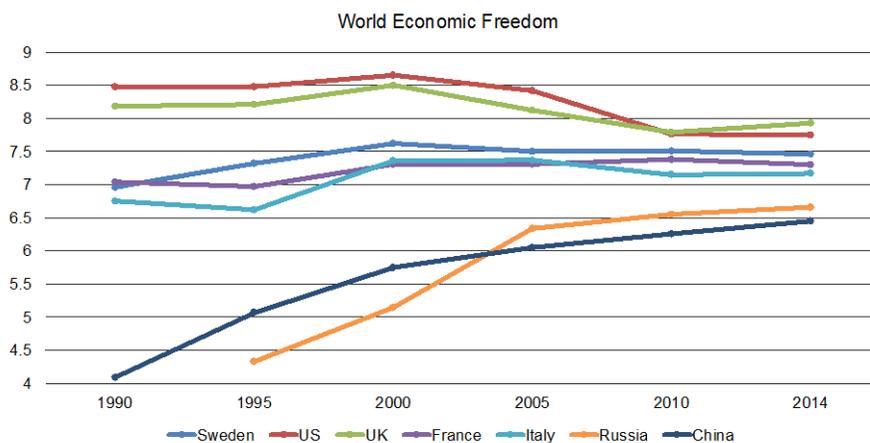
EURASIAN OUTLIERS: FORMER COMMAND ECONOMIES IN A GLOBALIZING SECTOR

The pendulum in Russia and China swings between the benefits of competition among rival firms in a free market model to the efficiencies of a single state owned enterprise. Presently, the consolidation of UAC and AVIC represents the far end of the spectrum with respect to centralized command and control. The Russian DIB subsists on export sales, while the Chinese firms enjoy government funding as they steal, acquire, and collaborate for technical advantage. Will either structure lead to long term success and deliver the innovation required remain competitive? The research suggests these systems are relatively fragile, and have an acute dependency on exports. For Russia, those must exports continue, and for China, they must grow. Any headwinds in this pursuit may retard the progress of a DIB along the developmental pathway.

V. GLOBAL AND REGIONAL STRUCTURE OF THE AEROSPACE AND DEFENSE INDUSTRY



Globalization: Economic Convergence



Fraser Institute

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VARIETIES OF CAPITALISM

To examine in detail the dynamics of defense-industrial affairs – the relationships between governments and industry – among true market economies, we will consider the cases of the United Kingdom, Sweden, Italy, France and the United States. As noted above, the United States stands apart in scale. “The United States is one of the very few nations – perhaps the only one – that can invest broadly in most technologies, and finance competing corporate structures in the case of the competition between Lockheed Martin and Boeing for the F-35 Joint Strike Fighter.”⁶⁵

The five Western defense markets can be broadly cast into three groups, viewed through the concept of “varieties of capitalism (VoC).”⁶⁶ On one side of the capitalist spectrum stand liberal market economies (LMEs). At the other side are coordinated market economies (CMEs). Among the five countries, the United States and Britain clearly number among archetypical LMEs. France and Italy are prime examples of CMEs. Sweden stands apart as an intriguing mix. Although it is safely classifiable as a CME, as will be discussed below, it shares significant characteristics with LMEs, putting it somewhere in the middle of the spectrum.⁶⁷ Each country’s VoC plays a central role in who and what influences as well as makes defense acquisition strategies and decisions. As pointed out by Marc DeVore, “[w]ithin this context, states with liberal market economies (LMEs) and coordinated market economies (CMEs) differ fundamentally in terms of the processes and forms of adaptation they undertake.”⁶⁸

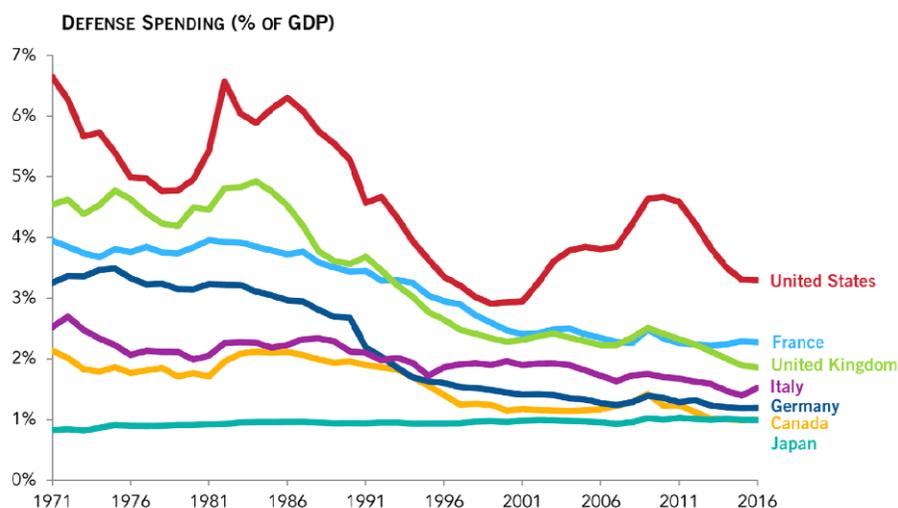
IN THE 1990s, TECHNOLOGY AND MARKETS COLLIDE

Autarkic approaches to defense acquisition that arose from all states’ foundational impulse to attempt to be self-sufficient in defense products are a persistent legacy. This legacy means that it remains difficult to speak accurately of even a European defense market, much less a global defense market, in the same way one would think of markets for more freely traded manufactured goods such as vehicles or personal computers. No matter the economy’s structural orientation, however, the survey of the five

points to the conclusion that defense markets have not escaped globalization and, perhaps more importantly, developed in similar ways. The result is that despite the profound differences between the LME and CME archetypes, all five markets appear on track to converge under a variety of pressures.



Declining Defense Budgets



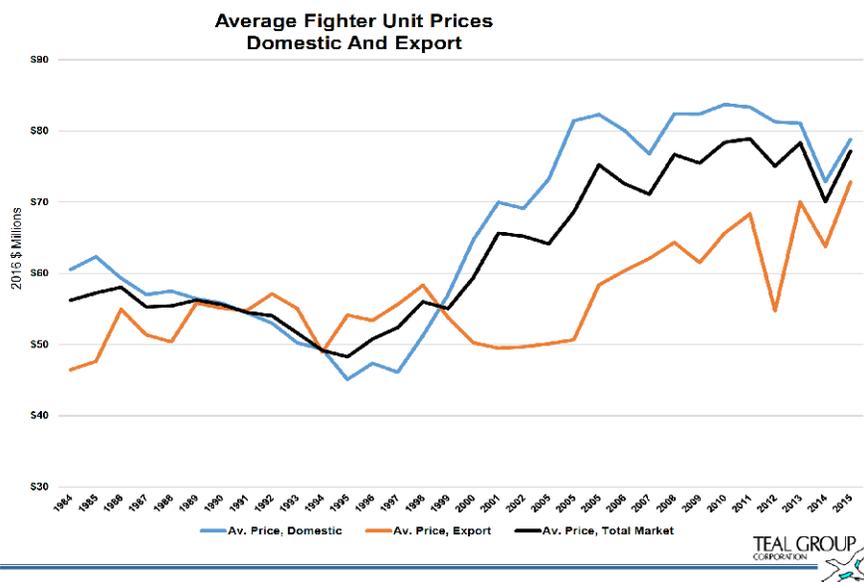
SOURCE: Stockholm International Peace Research Institute, SIPRI Military Expenditure Database, April 2017. Compiled by FGPF.

Unclassified

The watershed was the end of the Cold War and the near-simultaneous revolution in military affairs. The former triggered steep and prolonged decreases in military spending. The latter accentuated a long-term trend in the increasing complexity and cost of weapons. As Lazaric noted, “In the 1990s, design complexity increased with the development of what can be described as the set of systems that is interconnected by information and communication systems.”⁶⁹ This came on top of the “Technological developments since World War II [that] have propelled increases in the cost of major-weapons systems at a rate of six–ten percent per annum, whereas advanced industrial states sustained growth rates averaging two percent.”⁷⁰ As DeVore concluded, “Over time, the gap between escalating weapons costs and economic growth has undermined states in their ability to produce armaments autonomously.”⁷¹



Greater Cost & Complexity



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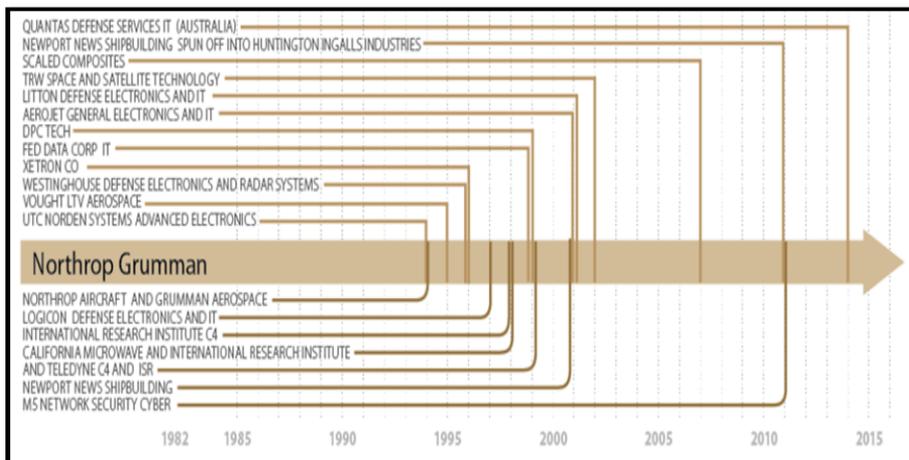
REACTIONS AND TRENDS

The five countries responded to these pressures with policy options arising from their distinctive VoCs, but with strikingly similar outcomes. All embraced consolidation of the number of defense contractors. All have sought the increased rigor and efficiency that exposure to market forces offers. All have increasingly emphasized exports as a means to support their defense-industrial bases. All encouraged increased collaboration within their respective defense markets and with international partners. All demonstrated a persistent schizophrenia between residual autarkic impulses and efforts to develop a global defense market. Most strikingly, however, all – whether their VoC traditionally would have supported it or not – seem to have inescapably resorted to choosing and fortifying at least one “national champion.” In sum, although many differing characteristics and propensities remain across defense markets in all five countries – and the process of convergence is uneven – contrary to views such as DeVore’s – the patterns of convergence among the West’s defense-industrial affairs are more telling than residual attempts to resist them.



Result: Consolidation across Markets

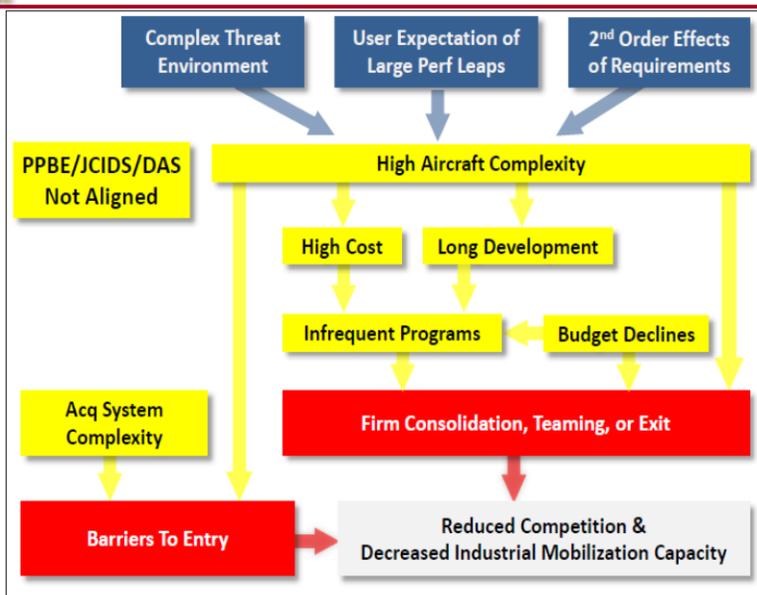
One example of industry consolidation, echoed across the American and European markets, leaving a series of national champions.
 Top-10 firms accounted for 85% of revenue in 2015.



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Accelerating Pressures



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THE UK: OVERVIEW

Britain resides at the extreme of the LME defense-industrial spectrum, arguably more liberal and open to market forces and outside investment than the United States. Although only the world's sixth-largest economy, it has the second-largest defense industry and represents five percent of the global defense market.⁷² According to Jane's, Britain had the largest defense budget in the EU at GBP40.8 billion (\$60.9 billion) as of 2016, equivalent to 2.1% of GDP.⁷³ As Jane's notes, its "defense-industrial

base, meanwhile, boasts world-class capabilities across most domains and is a major force in global export markets.”⁷⁴ The country is also among the world’s the top five exporters of military products, with exports of \$13.8 billion in 2012; \$16.75 billion in 2013; \$13.2 billion in 2014; and \$10.2 billion in 2015.⁷⁵ British defense and security firms directly employ 215,000 people, support a further 150,000 jobs, and have a combined turnover of around GBP30 billion (2014: UK government figures). As shown by the figures from 2012-2015, exports typically account for just over a third of output by turnover.⁷⁶

BRITISH VOC: THE QUINTESSENTIAL LIBERAL MARKET ECONOMY

As with the rest of the British economy, in the 1980s Thatcherism rolled back waves of nationalization that had taken place from the 1950s through the late 1970s in the defense sector. Thatcherism set Britain well ahead of a course that Italy, France, and much of the rest Europe were to pursue in the 1990s and after.⁷⁷ In Britain, however, the government went well beyond the partial privatizations the other European states later pursued. For key firms the UK retained a “golden share” along with varying prerogatives designed to safeguard the country’s ability to maintain particular military capabilities in its defense-industrial base.⁷⁸ In the exceptional case of the British Nuclear Group, the country’s provider of fuel for military and civilian reactors, the government retains full ownership.⁷⁹ Nonetheless, in the broadest sense Britain allowed markets to determine how its defense sector rationalized and consolidated from the 1980s onward, exposing the sector to market discipline.

The UK Government’s laissez-faire approach to market rigor crucially included a high degree of openness to foreign participation in the defense market in all senses, including ownership of “British” firms. This openness extended to even allowing foreign firms owned or effectively controlled by foreign governments to purchase British firms, as in the cases of Finmeccanica’s purchase of AgustaWestland and Thales’ acquisition of Racal. In fact, “British acceptance of growing foreign ownership in its defense industry is a core part of the UK government’s defense-industrial policy and was at the heart of its *Defense Industrial Policy* paper published in October 2002.”⁸⁰

A corollary to this approach to sustaining a defense-industrial base (DIB) by embracing foreign participation is that Britain chooses to treat foreign firms with a significant UK presence or substantial partnership in the same way as wholly-owned or traditionally British firms.⁸¹ This policy has caused U.S. firms, for instance, to develop a larger “on-the-ground” presence in Britain than in other European markets, in part seeking to use the UK as a regional hub.⁸² The result of this approach is the free acceptance in Britain of “multi-domestic firms” – whether with a European identity or not – in a way that sets the British DIB apart from the rest of Europe.⁸³ Overall Britain has been, “one of the most open defense markets in Europe and has shown a willingness to acquire important defense products and services from overseas suppliers while allowing extensive foreign ownership of the UK defense-industrial base.”⁸⁴

BRITISH DEFENSE-INDUSTRIAL RELATIONS

As an LME, hand-in-hand with the British government’s relatively laissez-faire attitude toward its defense industry is a rules-based, contractual, adversarial approach to interactions between governments and private concerns that requires officials and corporate executives to keep relationships at “arms-length.”⁸⁵ Tellingly, although the top-tier of British universities has historically been limited to a handful and future government officials and corporate executives attend the same institutions, the rules-based LME approach to government-corporate interactions has precluded the development of the sort of informal coordination dynamic that is most evident in the French case.⁸⁶ In this respect, the UK very much resembles the United States. Although some would view lack of technically trained civil servants providing oversight, “weak British procurement institutions, and a dearth of organizations facilitating strategic coordination” as a weakness, they are the very point of the market-oriented arrangement Britain has consciously chosen.⁸⁷

British plans for its procurement agency, Defense Equipment and Support (DE&S), provide a clear illustration of how the country continually seeks to strengthen its mix of rules-based, arms-length competition, even within government structures. According to Jane’s, in April 2014 DE&S:

“...began a three-year transition and transformation program aimed at transforming it into a commercially supported 'bespoke central government trading entity'. Among the key changes will be the introduction of a "hard boundary" between DE&S and the rest of the MoD; a separate governance and oversight structure with a strong board under an independent chairman; and a chief executive who will be accountable to Parliament.”⁸⁸

BRITISH SIGNALS TO THE MARKET: DETAILED TRANSPARENCY

Efforts to signal intentions to the market formally and regularly balance the absence of a strong web of informal coordination mechanisms in LMEs, including the United States and Britain. The British Government engages in frequent and regular planning efforts, the result of which are available for public consumption. A sampling of its efforts includes *Strategic Defense and Security Reviews*, which although evolved in name and format, have regularly appeared in 1998, 2003, 2010, and 2015. The 2010 *Review* set a ten-year rolling equipment acquisition plan, identifying for industry projected funding, equipment purchases, and force structure.⁸⁹ Similarly, the British Government transparently determines the lower threshold it sets for the profits it accords defense contractors, adjusting the rates annually and, in particular cases, based on risk, performance incentives, and the cost of capital.⁹⁰

BRITISH RESPONSE TO THE 1990S

As noted above, the fall of the Soviet Union threw into relief a convergence of defense-industry factors that accelerated change in the sector. The absence of an existential threat to Western states, at the same time that the sophistication and cost of weapons systems was accelerating, clearly forced choices upon decision makers. In Britain, the initial decision was to reinforce the market-oriented policy choices of the 1980s in terms of focusing on key capabilities and to seek to share costs and risks through collaboration, as Britain had done from at least the 1960s through a series of aircraft projects, starting with the SEPECAT Jaguar.

In the UK Government's words the decision was that, “the full spectrum of capabilities is not required [to be held by the UK] for large scale operations, as the most demanding operations could only conceivably be undertaken alongside the U.S., either as a NATO operation or a U.S. led coalition, where we have choices as to what to contribute.”⁹¹ This approach to collaboration was also signaled by the signing of a France-UK bilateral Defense and Security Co-operation Treaty in 2010.⁹² In terms of acquisition, it meant that Britain participated in a wide range of collaborative development and acquisition programs with an array of partners through varying structures, including the A400M cargo transport aircraft, the Eurofighter/Typhoon, Eurojet engines, the Boxer armored vehicle, air tanker leasing, and the F-35 Lightning II fighter.⁹³ Foreign participation in a DIB is not only about imports and inward investment, it is also about exports. In this respect, Britain, historically a leading exporter of military products, also remained focused on foreign markets to support its DIB as well as to lower the total per-unit cost of its own defense purchases through economies of scale supported by export markets.

NONETHELESS, A NATIONAL CHAMPION: BAE SYSTEMS

Despite the UK's laissez-faire approach to its DIB and openness to foreign participation, the resulting structure of the British defense market exemplifies a trend we see echoed across DIBs, whether they are in LMEs or CMEs. This is the creation and fortifying of a national champion, which points to a larger long-term pressure across all defense markets. This is the undeniable, underlying temptation within states to maintain certain core defense-industry capabilities if at all economically feasible. This appears to be the case for larger states with aspirations to play an independent international role (Britain, France, Italy, as well as Russia and China) and for those smaller states which have a successful history of DIB autarky and have faced significant security threats (Sweden, Israel). In the case of the UK, by some measures defense-industry consolidation has exceeded that of the other large economies, producing the world's third-largest defense firm with the founding of BAE Systems in 1999.⁹⁴ Although BAE shows the marks of Britain's LME approach to DIB policy – it is commercially owned and effectively multi-

domestic due to its large presence in the United States, the UK's policy of maintaining "golden shares" as well as shifting plans to maintain capabilities in key areas has nonetheless helped abet BAE's consolidation and status as a national champion.⁹⁵

BRITAIN'S RETRENCHMENT

Even the most laissez faire of LMEs, however, learned from experience the tradeoffs and tensions liberalization produces. By 1998, Britain began to draw back from an unfettered reliance on open defense markets, beginning with a shift to a "best-value" approach called "Smart Acquisition" and signaling a period of adjustment after privatizations were complete.⁹⁶ This shift accelerated with the 2005 Defense Industrial Strategy.⁹⁷ For instance, "[t]hrough a series of defense-industrial policy pronouncements, the UK has signaled that it would enter into long-term sole source sustainment contracts for some existing platforms and capabilities—indicating a shift from the open competition policy of the past.⁹⁸ In addition, the routinely high cost of complications of collaborative projects like the A400M has led the British Government, based on a deep series of experiences to begin taking a "relatively negative view of multilateral procurement programs."⁹⁹ According to one analyst, in addition to looking at best value as opposed to a straightforward transactional approach to acquisitions, the British Government is also increasingly considering the limits of "off-the-shelf" acquisitions on the British DIB, instead beginning to understand that, "[i]ndustrial capabilities are harder to regenerate than military ones; once they're gone they are harder to get back."¹⁰⁰

Another cost of pushing so much to a transactional market basis, to the extent that the UK privatized its defense research institution (QinetiQ), may be a decreased overall British pace of innovation. The conclusion is that Britain shares with other countries the market-driven realities of market consolidation, collaboration, and export reliance. What is striking is that despite its unique characteristics as the archetypical LME, Britain is nonetheless still driven back toward the persistent logic of retaining an enduring, indigenous DIB, in part through a national champion, regardless of the market principles.

SWEDEN: OVERVIEW

As is the case with Britain, Sweden by 2017 was firmly an LME in many ways, while perhaps retaining some lingering CME characteristics from social democracy's long dominance in Swedish politics, which last until the 1990s.¹⁰¹ However, the scale of the Swedish DIB is altogether different from that of the UK. While Britain is a major economy, among the world's top six by GDP, and is also among the largest half-dozen defense industries and exporters of military goods and services, according to World Bank figures, Sweden is a country of under ten million people and was the world's 22nd-largest economy in 2015.¹⁰² Swedish defense spending has averaged in the mid-\$5 billion range in the last five years, but in the context of a growing economy, represents a declining share of GDP at 1.13 percent in 2017.¹⁰³ Sweden's defense exports, however, are outsized relative to the size of its economy and population, averaging over the last five years \$1.1 billion with an overall export share of approximately 70 percent and in certain market segments close to 100 percent.¹⁰⁴ As noted by one analytical piece, "Sweden has privatized, and to a large extent, internationalized its defense industry... [t]herefore, it may be more accurate to speak of "the defense industry in Sweden" rather than "the Swedish defense industry."¹⁰⁵

SWEDISH VoC: AN LME WITH SWEDISH CHARACTERISTICS

While no market economy, particularly with regard to the defense sector, is a pure LME or CME, countries more firmly in either camp deviate largely by exception, whereas Sweden's evolution and purposeful mix of tools from both approaches is a central feature of its defense-industrial policy. DeVore rightly notes, "[t]he trademarks of Sweden's defense-industrial system were close cooperation between industry and government, incremental innovation, and the financial stability provided by "patient" bank capital.¹⁰⁶ This is no more evident than in the case of Saab, effectively controlled by the extended Wallenberg family, which as recently as 2016 DeVore described as working in close collaboration with the Swedish Government, as part of a "broader corporatist pattern of economic governance."¹⁰⁷

Corporatist economic governance in Sweden, however, did not take the form of overreliance on state ownership, as it might have elsewhere. Unlike Britain, France, and other European states, it did not have a history or experience of sweeping nationalizations of broad sectors of the national economy. Instead, Sweden remained broadly open to using private-sector market structures to ensure the most efficient development and production possible.¹⁰⁸ Although the following quote refers to recent offset policies related to Swedish purchases of defense imports, it exemplifies Swedish attitudes toward the proper orientation of the Swedish DIB from World War II to the present: "...both government officials and company representatives have confirmed that offsets are used to develop or maintain military and security competence, and not to provide employment or random industrial development."¹⁰⁹ Instead, up until the 1990s Sweden's CME or corporatist behavior expressed itself through an a partial autarky that insisted on being able to reproduce military technology domestically, but not insisting in all cases on autonomously innovating military technology, as in France's case.¹¹⁰ This policy of locally sourcing production ensured that Sweden's defense industry was assured of producing a wide and deep array of defense products domestically throughout the Cold War, while somewhat ameliorating the sovereignty price Sweden had to pay.¹¹¹ Sweden's DIB, however, was effectively closed to outside investment.

SWEDISH DEFENSE-INDUSTRIAL RELATIONS

Sweden's LME orientation means that it resembles Britain in terms of its market orientation, but retains a corporatist tendency arising out of the country period of production autarky. This may be in part because of the relatively small scale of both the Swedish DIB as well as Swedish society. As a result, in the pre-1990s period, "Sweden's government eschewed competitive bidding and formal contracting in its interactions with its defense-industrial base in favor of consensual decision-making and cooperative policy implementation," or as one executive put it, "Kockums was used to smooth processes with the customer [the Swedish government] based on trust and a long working relationship – you agree and shake hands and that is that."¹¹²

The country also differed from Britain and tilted toward CME practices by having a strong procurement agency, the Swedish Defense Material Organization (known by the Swedish abbreviation FMV). FMV controlled funding for the innovation that Sweden chose to pursue, standing up the innovation cluster surrounding Saab's aviation business at Linköping, in part by arranging for the local university to focus on training a cadre of engineers to staff Saab and support defense-related research.¹¹³ As DeVore notes, FMV has also "funded ambitious process-innovation projects aimed at enabling Saab to compete effectively as a systems integrator despite Sweden's high labor costs and limited domestic economies of scale."¹¹⁴ The entire Swedish defense-product innovation and development system was geared toward taking proven technologies and pursuing gradual, incremental improvements.¹¹⁵

SWEDISH SIGNALS TO THE MARKET: TRANSPARENCY, BUT BACKDOOR COORDINATION

Much like the UK, Sweden promulgates defense-policy strategies, reviews and guidance with regularity. This gives the appearance of transparency and perhaps echoes the procurement predictability of the post-World War II era that led to the "hand shake" culture noted above.¹¹⁶ Sweden's most recent defense review, "Swedish Defense Policy 2016 to 2020," was published in 2015, but in light of security developments in the Baltics and Ukraine, a knowledgeable Swedish contact concluded in the first half of 2017 that it was already in need of significant revision. Moreover, the same contact explained that although Swedish defense-industrial relations are not adversarial, the degree of collaborative communication through FMV or other government channels has severely atrophied as Sweden focused from the 1990s on restructuring the industry, privatization, and Sweden's DIB policies, rather than on tending to the organic links between FMV and industry. Nonetheless, the Wallenberg family's effective control of Saab Group and strong ties to Sweden permit an informal channel through which the Swedish government's policy preferences can still be communicated and recognized.

SWEDISH RESPONSE TO THE 1990s

Sweden's response to the end of the Cold War and resulting defense budget "peace dividend" at the same time as the RMA and the related growth in per-unit military costs, was condensed into the space of the 1990s. Although the country chose policies similar to the UK's, Sweden did not have the head start Thatcherism provided. In addition, Sweden's lingering legacy of greater corporatism entailed a greater degree of government management of the restructuring of the DIB.

The sharpest change in policy was in terms of the country's approach to autarkic production. As characterized by DeVore, "[u]nder the new strategy, Sweden no longer attempts to maintain autonomy in all areas of military production, but designs, develops and produces only those systems and capabilities they cannot acquire elsewhere."¹¹⁷ Recognizing that its declining defense budget could not sustain as broad a DIB as some other countries, the country took the decision to almost fully expose the DIB to market forces. Sweden began privatizing its 11 state-owned defense enterprises in 1997. It did not retain "golden shares," nor did it retain government ownership of any firm, as Britain did. FMV, however, played a far more active role in managing the opening of the Swedish DIB to foreign direct investment. It first identified which capabilities would initially be opened and then "actively negotiated many of the mergers of Swedish firms with multinational corporations in the hope the foreign ownership might preserve some local capabilities beyond certain core technologies."¹¹⁸

The subsequent approach of "buying to meet demands...and not to protect Sweden's industrial base" and accepting supply-chain dependence, coupled with several other extreme LME policies, set the stage for a broad opening of the Swedish defense market to the rigors of international competition.¹¹⁹ Going well beyond Britain's reforms to be competitive, Sweden does not require foreign firms to have a local presence nor to partner with local counterparts to compete for FMV contracts.¹²⁰ As one analysis characterized the situation, however:

Through various investment approval procedures and manufacturing licenses, Sweden ensures that significant defense production capabilities remain onshore, and that foreign-owned Swedish defense companies continue to have access to the most advanced technologies available. Thus, the internationalizing of Sweden's defense industry reflects Sweden's commitment to a collective security policy that links Swedish strategic goals with those of the Nordic countries, the EU and the United States.¹²¹

One further, dramatic shift involved a changed approach to exports. Although Sweden had long exported defense products, before the 1990s it had restricted them to politically safe customers – fellow Nordic countries and neutrals such as Switzerland and Austria. In the 2000s, Sweden's defense exports grew to the extent that it was sometimes the world's top per-capita exporter and more often the second after Israel, in contention with Russia.¹²² In addition to the 70 percent export share noted above, Swedish firms' R&D rose to approximately 20 percent of turnover. According to the most recent Stockholm International Peace Research Institute figures, the country ranks 12th in terms of absolute export value.¹²³

NONETHELESS, A NATIONAL CHAMPION: SAAB

While it generally adhered to strong LME principles, Sweden nevertheless abetted the consolidation of a national champion in which it has increasingly grouped the core defense capabilities it plans to retain domestically: fighters, submarines, and electronic systems. As various analysts have put it, the "government collaborated with the Wallenberg business group to consolidate Sweden's most valuable defense businesses," Celsius's missiles and Ericsson's electronics alongside Saab's aerospace, radar, and sensor businesses to fortify a national champion.¹²⁴ As of 2014, Saab had come to represent more than 80 percent of Sweden's overall defense turnover and 25 percent of its R&D.¹²⁵

SWEDEN'S RETRENCHMENT

As with Britain, however, vigorous reform did not come without subsequent adjustment to unintended consequences and a resulting attenuation of LME principles. This was evident on the three fronts: foreign ownership, collaborative developments, and reliance on exports. Experiences with foreign ownership was mixed in how they affected Sweden's DIB. Saab attempted to forge a strategic partnership with BAE Systems, which acquired a 35 percent stake, planning to make use of BAE's broader global presence.¹²⁶ Saab, however, proved unaccustomed to the degree of sway a peer international partner would expect such an ownership stake to entail and the arrangement was unraveled.¹²⁷

A more striking example of how foreign direct investment (FDI) could be unpalatable to Sweden came from German submarine builder Howaldtswerke-Deutsche Werft's (HDW's) Swedish Government-facilitated purchase of state-owned shipbuilder, Kockums. HDW deemphasized Kockums submarine development and marketing in favor of its own products, even in past Kockums markets like Australia and Singapore. Stockholm's assessment that HDW's approach would gradually cause Kockums to wither resulted in intense Swedish Government pressure on HDW, to the extent that an armed Swedish Armed Forces detachment raided Kockums' facilities to seize government-owned intellectual property. The end result, at the behest of Sweden, was the sale of Kockums to Saab, further strengthening the national champion. Sweden also learned the lesson that, "FDI can be motivated by the desire to suppress competitors rather than achieve corporate synergies in such a highly mercantilist and, oftentimes, oligopolistic industry as defense."¹²⁸

The Swedish MoD's 2009 Defense Acquisition Strategy reiterated a policy of pursuing collaborative development when it was not possible to upgrade existing equipment or acquire material "off-the-shelf".¹²⁹ Despite that policy and although Swedish industry acknowledges the need for joint development and collaborative projects outside of equity investments, examples are rare. Saab is now pursuing the jointly developed and produced TX trainer with Boeing. Otherwise, however, "Sweden to date has not become a partner in any major European multinational program."¹³⁰

A factor particular to Sweden in terms of retrenchment after reform was a fresh reticence to export, based on Sweden's long-term commitment to international human rights and rule of law. In particular, a Euro 300 million Saab sale of missiles to Saudi Arabia triggered a popular backlash against the Swedish DIB's new export-driven model.¹³¹ After the 2014 general election brought to power a minority government led by the Social Democrats, the new coalition shuttered the Swedish Defense and Security Export Agency.¹³² At the same time, the government initiated a review of export control policies, potentially undercutting the model that has sustained the Swedish DIB over the last 15 years.

ITALY: OVERVIEW

Italy is quite apart from Britain, Sweden, or the United States. Its economy is firmly rooted in a legacy of CME/corporatist practices dating far back into periods of paternalistic patterns of governance. This was most profound during the fascist regime of 1926-1943, but extended in various forms into the post-World War II era.¹³³ Italy has attempted and implemented market-oriented reforms in the last three decades, with some success. An EU and NATO member state, it is the fourth-largest defense market in the EU and 12th largest in the world and, as with most other European members of NATO, military spending has been anemic since the early 1990s.¹³⁴ This decrease coincided with the end of the Cold War, at the same time Italy faced ongoing fiscal challenges and extended periods of low GDP growth, prolonged by the 2008 financial crisis. According to Jane's, defense spending was \$23.1 billion in 2016, the equivalent of approximately 1.3 percent of GDP.¹³⁵

As one analyst observed, "[t]he Italian defense industry is structured as a pyramid, featuring at the top four big corporations (Finmeccanica, Fincantieri, Avio, and Iveco)."¹³⁶ Italy is firmly a "middle power" that recognizes that it cannot defend itself independent of an alliance network.¹³⁷ As a result of – and despite the challenges just outlined – the country has chosen to step up its international role, particularly in coordination with the United States. This allows Italy to set its EU relationships (France and Germany) in a broader, transatlantic context, somewhat as Britain does. A clear example of Italy's

activity is its use of air assets, with Rome having employed combat aircraft, “in ten international crisis operations in the last 24 years.”¹³⁸

ITALIAN VOC: A LONGSTANDING CME

We have moved steadily along an economic spectrum from a clear LME in Britain to a clear CME in Italy. The Italian government wields considerable direct authority over defense firms as well as continues to own directly a substantial portion of its DIB. Italy holds approximately a third of the holding company that controls leading defense firm Leonardo (formerly Finmeccanica), with most of the rest held by Italian shareholders.¹³⁹ Similarly, the government holds 70 percent of naval shipbuilder Fincantieri.¹⁴⁰

As opposed to Britain and Sweden’s openness to foreign investment, Italy has tight controls governing its leading defense firms. As Jane’s notes, Rome “has far-reaching powers to exercise influence over the national defense-industrial base, including the right to veto acquisitions and impose production continuity obligations on companies operating in strategic areas” and the exercise of “special powers including the vetoing of or placing of conditions on corporate decisions.”¹⁴¹ In the case of Leonardo, “no one, except for the [Italian] State, public bodies, or entities controlled thereby and any other party authorized by law, may possess, on any basis, shares in the company that constitute a shareholding of more than three percent of the share capital represented by shares with voting rights.”¹⁴² This collection of DIB policy instruments is so out of fashion that it has proven controversial in today’s EU, despite many member states’ past interventionist histories.¹⁴³

Although as early as 1948 the Italian state set profitability as an objective for Finmeccanica, the governments continued to provide “vast government funds to cover heavy losses” into the late 1980s.¹⁴⁴ An argument can be made that long-term state ownership and direct policy engagement has provided Leonardo “continuity and strategic perspective,” been a “stabilizing factor,” as well as permitted the firm to take a longer view toward financing investments.¹⁴⁵ In any case, Leonardo is not only the dominant Italian defense conglomerate aside from naval systems, it provides a clear signpost for Italy’s “propensity to stick to the traditional concept of national interest and security.”¹⁴⁶ In the case of foreign investment, the Italian government pressures outside firms to take Leonardo or another Italian firm as a partner, as was the case when Carlyle Group acquired Avio, a supplier of rocket, naval, and aircraft engines, as well as gas turbines and parts. Italy compelled Carlyle to accept Leonardo as a “leading industrial partner, with a 30 percent share” to keep key Italian management in place.¹⁴⁷ This approach extends to acquisition policy in which, unlike the British or Swedish cases, Italy requires robust offsets and expresses a clear preference for foreign firms to partner with Italian ones.¹⁴⁸

ITALIAN DEFENSE-INDUSTRIAL RELATIONS: CORPORATISM REIGNS

Having sketched out the Italian government’s deep involvement in its defense industry above, government-industry relations do not require extensive treatment. The government is clearly in the driver’s seat, with Leonardo, Fincantieri, and the others serving as instruments of government policy. The government’s control over who is Leonardo’s CEO makes this clear and often involves the selection of executives of proven value to the government, but unconnected with and inexperienced in the defense industry. Such was the case in the most recent CEO changeover in April.¹⁴⁹ It is therefore unsurprising that Leonardo must, “at times must take steps to satisfy the government that may not fit in the company’s overall strategy.”¹⁵⁰ The structure of Leonardo and much of the rest of the industry is designed to be responsive to government interests. The government-industry relationship is in no way configured to be rules-based, contractual, or adversarial. Unlike Sweden, the “Italian procurement authorities are trying to optimize a calculus that may not be possible over the long term: ensuring national jobs and technology while promoting more competition and more efficiency, and balancing between U.S. and EU relationships and rules.”¹⁵¹

ITALIAN MARKET SIGNALS: A TREND TOWARD MORE TRANSPARENT PLANNING?

As recently as 2009 it could be claimed that Italy had “not articulated a formal national industrial

policy” and that the Italian “procurement system is generally one of the least transparent and rule-based” among a diverse selection of NATO and similar countries.¹⁵² Italy has attempted to change this lack of transparency and guidance by promulgating in 2015 a *White Paper on International Security and Defense*. The *White Paper* attempts to define Italy’s DIB by dividing capabilities Italy seeks to maintain into sovereign and collaborative or European technologies.¹⁵³ The *White Paper* does not identify the technologies in detail, but helpfully foresees a future system of policy documents that might provide the sort of guidance that is common in LMEs. In this case, the General Secretariat of Defense’s National Armament Directorate is responsible for preparing a *Technological and Industrial Strategy* (TIS).¹⁵⁴ In theory, this new structure of policy guidance could create a clear template for when Italy will choose to pursue development and acquisition independently or as independently as possible, and when it will rely on European or other forms of international collaboration. Whether the pursuit of a paperwork structure will actually influence Italian policy will remain to be proven with experience.

ITALIAN RESPONSE TO THE 1990S

The preceding information should not lead to the conclusion that the Italian DIB policy has been turgid. Rather, just as in Britain and Sweden’s cases, Italy has responded dynamically to the confluence of challenges the 1990s presented. Italy partially privatized its DIB, internationalized it, and intensified engagement in collaborative projects. Italy entered the 1990s with a debt to GDP ratio in the range of 120 percent, steepening the challenge Rome faced on top of those faced by other Western DIBs and triggering a clear need for real reform.¹⁵⁵

Even more so than had been the case for Britain or Sweden, the pressures on the DIB made privatization a necessity to reduce Italy’s exposure to firm losses. Italian policy-makers understood that the structure of the industry in not only Italy, but also in Europe, required rationalization and that “the days of true nationally fed ‘national champions’ [were] ending.”¹⁵⁶ For Leonardo, partial privatization came in 2002.¹⁵⁷ Although the Italian government’s share of ownership had fallen to only a third, *de facto* state control, as well as an ongoing, understood political guarantee underwrote a campaign of internationalization that has fundamentally shifted the firm’s orientation.¹⁵⁸ Privatization, even partial, came with access to private capital and much greater exposure to the rigors of the market and tremendous gains in per worker turnover.¹⁵⁹ As Felice noted, “[t]hereafter profits finally became substantial and profitability indicators reached acceptable levels: by 2006 return on investments was more than four percent, and returns on equity, almost 20 percent.”¹⁶⁰ Simultaneously, R&D expenditures shot up beyond the levels of European competitors such as Airbus and Thales.¹⁶¹

Italy’s drive for defense internationalization looked both to Europe and the United States. As already noted, Rome sought to strengthen both transatlantic and European ties, using each to balance the other and provide the country resilient options. Although Italy’s leadership was enthusiastically “European” in orientation to the EU and associated projects, it “did not see a European vocation and the American alliance –as well as a greater degree of national autonomy over foreign policy– as mutually exclusive alternatives.”¹⁶² Indeed, a stronger international orientation would allow Italy to somewhat level the political playing field in Europe with regard to Germany and France.¹⁶³

We will discuss successful “internationalization” of the Italian DIB in more numerical detail below regarding Leonardo. An example of Italy’s intense DIB coordination was that, “...the Italian ambassador, Giovanni Castellaneta, was appointed to the [Leonardo] board in 2004 and was then nominated to head the Italian embassy in Washington, D.C., while maintaining his role within the company.”¹⁶⁴ Taking 70 percent government-owned naval shipbuilder Fincantieri as another case in point, however, one sees that although Italy obstructed the international penetration of its home market, Italian firms were active in engaging abroad. For example, Fincantieri acquired a \$120-million majority stake in U.S.-based Manitowoc Marine Group (which encompassed Marinette Marine and Bay Shipbuilding Company) in 2008, positioning itself to be a direct participant in the littoral combat ship program.¹⁶⁵

This is where it is also appropriate to point out that Italy’s political orientation toward overseas military operations with the United States and partners served tangible defense-industrial goals. On the one hand, it entailed a requirement that Italian forces be equipped to a standard that would permit them to

work with first-rate militaries, such as those of the United States and Britain. On the other hand:

The fact that Italian military forces were deployed with Americans in a number of missions abroad, including special operations and counterinsurgency campaigns in Iraq and Afghanistan, as well as the pro-U.S. stance of Italian governments on most international issues, played a role in strengthening the credibility of Italy as a staunch ally of the United States as well as a reliable supplier of defense equipment.¹⁶⁶

Finally, Italy already had a history of participating in big-ticket development and acquisition of military hardware with European partners, as in the cases of the Panavia Tornado (Italy, the UK, and Germany) the Eurofighter (Italy, the UK, Germany, and Spain), and the Horizon-class frigate (Italy, France, and initially the UK). It also participated in joint ventures with Thales.¹⁶⁷ Interesting as these examples are, Italy's most rigorous, market-oriented approach was clearly evident in the case of the Lockheed Martin F-35 project. For the F-35, Italy abandoned the principle of *juste retour*, positioning Leonardo subsidiary Alenia Aermacchi, to serve as a strategic second source of F-35 wings, "as long as it can keep their price lower or equal to that of the units produced by Lockheed Martin."¹⁶⁸ Overall, 90 Italian companies are involved and the contracts awarded to the Italian industries have an overall value of \$715 million.¹⁶⁹

Internationalization also serves the purposes of potentially facilitating DIB capability building and innovation.¹⁷⁰ Building on infrastructure at Cameri, which hosts a logistics hub for Panavia Tornados and now Eurofighters, Italy secured a final assembly and check out/maintenance repair overhaul and upgrade (FACO/MRO&U) facility as part of its participation in the F-35 program.¹⁷¹ With the exception of a U.S.-operated facility for testing and measuring the stealthiness of aircraft:

[e]very other FACO structure will be built by Italian industry and managed by non- American staff, with an intensive planned interchange with Italian staff tasked with carrying out repairs on other aircraft components. These activities will entail the acquisition of a considerable transfer of technology in order to perform aircraft assembly and test/certification activities.¹⁷²

The FACO will also stand the prospect of attracting MRO&U work from European users of the F-35 around the continent.

NATURALLY, A NATIONAL CHAMPION: LEONARDO

As should already be evident, despite Italy's reform steps from the early 1990s onward, it followed a path to the creation of a national champions, also trodden by Britain and Sweden, but after a different fashion.¹⁷³ The insight Italy shared with the other two very different economics was that even though, "the days of true nationally fed 'national champions' [were] ending," internationalization and collaboration could offer a champion a different model.¹⁷⁴

Domestically, the Italian government consolidated multiple firms into either Leonardo or Fincantieri.¹⁷⁵ Among examples were Alenia Aermacchi, Marconi Mobile Holding SpA, and Telespazio SpA.¹⁷⁶ The result was that Leonardo became Italy's second-largest manufacturing firm and directly employs 70,000 workers as well as subcontracting with a plethora of small- and medium-size firms.¹⁷⁷ From at least 2009, Leonardo accounted for approximately 70 percent of the Italian defense research and technology as well as procurement budgets.¹⁷⁸ The collection of capabilities in Leonardo also resulted in its being, "Italy's leading high-technology business."¹⁷⁹ All in all, the firm has the full the attributes of a national champion.

Much like BAE Systems, moreover, Leonardo has transformed into a national champion with a very balanced, strong international orientation. With the full acquisition of AgustaWestland, it became the UK's second-largest contractor after BAE.¹⁸⁰ More impressive, however, is the change in its sources of revenue. Leonardo's 2007 revenues proportionately by region compared with 2015's were as follows, showing a greater diversification of the firm's geographic engagement, particularly with regard to the United States:

	<u>2007</u>	<u>2015</u>
Italy	33%	16%
UK	16%	14%
N. America	11%	25%
ROW	15%	18% ¹⁸¹

ITALY: NOT RETRENCHMENT, RATHER FURTHER RATIONALIZATION

While Italy has responded to pressures similar to those faced by Britain and Sweden, its “retrenchment” after a period of reform appears to be of a different nature. The government did not go nearly as far as the other two in terms of “letting go” of ownership and control. Instead, Italy chose a much milder form of privatization and adjustment, fundamentally not abandoning its CME/corporatist culture of managing its DIB. It nonetheless pursued consolidation, embraced foreign investment and collaboration, emphasized exports, sought market rigor, and built a national champion, all in the service of maintaining employment and a DIB.

Since Italy did not pursue as aggressive an opening as the other two countries did, it does not yet face the issue of retrenchment or pulling back from reform excesses. It remains to be seen whether the path Italy has chosen will be sufficient to preserve much of its DIB, although the trend for now appears tentatively positive. As Jane’s notes, “[b]udget constraints and the need to maintain both capability and the relevance of Italy’s defense industry in a European context suggest that Italy will continue to look to multi-national solutions to meet national requirements.”¹⁸²

What is certain, however, is that the legacy of Italy’s traditionally decentralized industrial base of small and medium firms, as well as the decentralized approach to corporate structures that tends to occur during consolidations there, means that Leonardo has a distance to travel to become “one company.”¹⁸³ As Felice explains, “[t]he company inherited many lines of production, characteristics of which were typical of the early twentieth-century big business—based on economies of scale—yet these had come into the group rather by accident, not as a result of strategic planning.”¹⁸⁴ In short, Leonardo became the Italian national champion in aerospace and defense, yet the cluster of firms that comprised the organization has not yet become a truly integrated group, with a common objective and strategy. As Leonardo seeks “to revamp the company’s traditionally decentralized structure by making each of the individual companies into divisions,” hoping “to eliminate overlap and better allocate investment between helicopters, aerospace, defense electronics and space based on potential return,” it will struggle to maintain a coherent, competitive focus.¹⁸⁵ Transforming while simultaneously competing is a steep challenge.

FRANCE: OVERVIEW

France is a CME, with a deep pattern of coordinated state-private sector interaction dating back at least to the 17th century during the time of Louis XIV’s chief minister, Colbert, who was something of a grandfather to statism and modern-day *dirigisme*, the concept of state direction of the national economy. According to World Bank figures, France was the world’s sixth-largest economy in 2015.¹⁸⁶ Jane’s calls France, with the EU’s second-largest defense market and budget of almost \$45 billion, “an engine of European integration in general and a strong proponent of greater intra-community defense and security co-operation.”¹⁸⁷ As Jane’s describes, “France possesses a highly developed and technically sophisticated defense industry capable of independently producing the most advanced and complex systems. It is one of the few countries in the world that can boast a full spectrum of capabilities in all military and security domains, including the design and development of nuclear systems.”¹⁸⁸ France claims that its DIB accounts for 25 percent of the EU total.¹⁸⁹ Indeed, analysts estimate that the sector’s 5,000 firms employ directly 165,000 people and indirectly 400,000.¹⁹⁰ France is among the world’s top-five defense-products exporters, jockeying with China, Germany, and the UK for position, but far behind the United States and Russia.¹⁹¹ France’s defense export order book totaled approximately \$9 billion in 2014 and \$18.5 billion in 2015.¹⁹²

As indicated above, the French government, “plays an extensive role in planning, structuring, building and governing firms.”¹⁹³ Particularly from the time of President de Gaulle, French policy was one of strategic autonomy, under which the DIB was not only a key component of the country’s economy and employment, but also perhaps the essential ingredient to France’s policy independence.¹⁹⁴ Similar to Italy’s case, France’s DIB encompasses a mix of state and private ownership, with the DIB subject to a “complex web of shareholdings.”¹⁹⁵ As Jane’s explains using Dassault as an example, the company, “holds sway over both Thales (it holds 25% of the company) and therefore shipbuilder DCNS (in which Thales holds a 35% stake) but is yet subject to the same threat by Airbus’ minority blocking stake in its company (Airbus holds 9% of the company).”¹⁹⁶ Although France’s DIB firms are for the most part under *de jure* private management, the French state’s instruments of influence and control should not be underestimated. In the past, for example, Thompson-CSF (now Thales) and Aerospatiale (now part of Airbus) although “private,” relied on the government for more than 50 percent of their capital.¹⁹⁷

Weiss and DeVore accurately describe that, “France is endowed with multiple institutions and organizations that facilitate non-market coordination by defense industries. In particular, the Ministerial Delegation for Armament (DMA, renamed the [Directorate General for Armament] DGA in 1977) shapes aircraft policy by giving armaments producers greater input into policymaking processes.”¹⁹⁸ We will discuss below DGA in more detail. It suffices to note here that the French government maintains control over defense firms not only through ownership stakes, but also based on legislation that gives Paris the power to block foreign acquisitions of companies in the sector.¹⁹⁹ The effect has been such that, as Lundmark records, “France is different in Europe in that it has not allowed any substantial foreign acquisitions of French defense companies.”²⁰⁰

FRENCH VOC: THE QUINTESSENTIAL CME

France’s DIB is not only tightly managed by the state, it is also highly concentrated. Moura and Oudot cited that in 2012 the country’s top-ten firms represented 82 percent of turnover in the section, decreasing to 75 percent in 2013 (in 2013/2014, the figure for the UK was 41 percent).²⁰¹ Similarly, small and medium enterprises were 67 percent of all defense-sector exports, but their exports only accounted for four percent of the products’ value in 2013, with large enterprises making 93 percent of exports.²⁰² Moreover, unlike in the United States, “French decision makers are constrained to bilaterally negotiated agreements” with firms and do not operate in an environment where dual-sourcing strategies and much competition are possible.²⁰³ In fact, one study noted that, “a review of the top 72 French defense programs by value during the period 2006-2008 shows that only eight programs worth \$1 billion (three percent by value) were awarded competitively.”²⁰⁴

FRENCH DEFENSE-INDUSTRIAL RELATIONS: A TIGHTLY KNIT COMMUNITY

As with Italy and quite different from the Britain and Sweden, the government and defense firms are in effect a one enterprise, despite ownership structures. In part this is because France has a tradition of “*grandes écoles*,” professional schools that train both government and private-sector personnel, who are expected to remain in contact and to cycle to and from jobs in both sectors. DGA recruits its armaments engineers from France’s leading engineering school, the *École Polytechnique*, from which the leading defense-firm engineers also graduate. French firms rely on detailed and retired DGA personnel to staff key jobs, even more so than U.S. firms recruit former officers and Defense Department civil servants to serve in supporting but not necessarily leadership roles.²⁰⁵

This cohort of personnel passes back and forth between government and industry, creating ample informal channels for coordination, communication, and consensus among a DIB policy elite that manages France’s defense sector. As Weiss and DeVore aptly outline:

Because of the French state’s predominant role in providing industrial credit for and, in many cases, owning (outright or partially) large firms, members of France’s civil service elite are frequently ‘parachuted’ into leadership positions within corporations. As a result of such dynamics, corporate leaders and public policymakers possess an inherent capacity for coordinating their activities and influencing each other’s internal decision-making.²⁰⁶

One byproduct of these relationships, however, is that control and influence can run strongly both ways. DGA and its allies have often been able to undercut their political leadership's desire to pursue joint programs with European partners.²⁰⁷ Conscious decisions not to pursue system interoperability with NATO allies in the 1960s underwrote France's autonomy, but also had the potential to isolate it operationally.²⁰⁸ Choices surrounding the push for autonomy, strongly supported by the graduates of the *École Polytechnique*, boosted the sovereignty price of that option higher. DeVore highlighted a prime example, noting that relying on international sourcing meant that Saab's JAS-39 Gripen cost \$3 billion to develop, while France's go-it-alone approach to the Dassault Rafale resulted in a \$13 billion development bill for the fighter.²⁰⁹

FRENCH SIGNALS TO THE MARKET: AN ALTOGETHER DISTINCT APPROACH

In light of France's coordinated, non-adversarial approach to defense-industrial relations, signaling to the market is not an issue in the same way it would be in the United States or Britain. A symptom of this is the infrequency and irregularity of France's defense-planning documents, with extended gaps in revising defense strategies. This was most notably the case with the 14-year gap between white papers from 1994 to 2008, with the most recent dating to 2013.²¹⁰ Instead, a more reliable indicator of France's military procurement trajectory and plans is its regular military programming law (*loi de programmation militaires* or LPM), which operates on a seven-year cycle and allows for a medium-term focus on investments.²¹¹

Nonetheless, what is important in coordinating France's DIB is not transparency, but the informal channels and connections that influence policy and result in decisions formally confirmed through LPMs and the occasional white paper. The French defense-industrial ecosystem is able to communicate and execute more seamlessly than the adversarial ones in the United States and Britain, but it also has more scope to resist change due to opacity and is more likely to be concerned with the displacement of workers and assets in periods of adjustment.²¹² As Markusen and Serfati assessed, "although in France such unitary relationships between key industries and the state have been on the wane since the early 1980s, the defense sector has been an important exception."²¹³

FRENCH RESPONSE TO THE 1990S

Pressures on the DIB that became obvious in the 1990s struck France particularly hard and France's preference to be autonomous came back to haunt it. Participation in the 1991 Gulf War was revealing for the French Government. France's conscious choice in prior decades to avoid interoperability, "relegated it to a secondary role on a remote front" and laid bare inadequacies in the face of the RMA.²¹⁴ As recounted by Lungu, President Chirac perceived European cooperation "as the only realistic avenue for obtaining those assets indispensable for balanced relations with the United States in advanced military capabilities" and French analysts identified the RMA with the broader forces of economic globalization.²¹⁵

France's adjustment was nonetheless slow, indeed much slower to develop than those in the Britain and Sweden. As implied above, Paris undertook reform in reaction, which gained momentum as the French Government observed industry consolidation in other markets.²¹⁶ While consolidation finally came to France in 2000, "[n]ational defense-industrial capacities were, and still are, characterized by inertia and national logic."²¹⁷ France tended to seek to remain present in a broad area of technologies, but spread thinly, therefore having a tendency to be weak in most of them.²¹⁸ The country was also careful to balance out reducing state ownership of assets by stipulating "'*action spécifique*,' the French counterpart of the 'golden share.'"²¹⁹

As a prime driver of the "European Project," the French Government also turned to Europe for options. For France, the EU had always been an instrument for strengthening the country's position vis-à-vis the United States, Russia, and the world writ large. France now began to extend that concept more vigorously to European defense cooperation. In theory, France could shift, "its traditional Gaullist policy of *National Autonomy* to a neo-Gaullist policy of *Strategic Autonomy* centered on building a stronger *European* defense capability."²²⁰ In this context, it is enduringly important to hold in mind that for France,

the EU is foremost a political project, with economic considerations somewhat a second consideration. Joana and Smith correctly identified a broader truth of the symbolic importance of European cooperative projects when they noted regarding the A400M:

[r]ather than just ‘plugging an operational gap’, the program was seen as a means of relaunching ‘the Franco-German couple’, encouraging the integration of the European defense industry or reforming the procedures of military procurement. In other words, the program was used by different actors motivated by objectives that are often far removed from the question of efficient military transport.²²¹

As Lungu points out, “not only France, but also other leading continental European nations began to fully understand that in the strategic high-technology industries, mergers also decide whether a nation, or an integrated bloc of nations like the European Union, maintains the industrial and economic guarantees of sovereignty.”²²² Therefore, although the French DIB elite, coordinating with allies in DGA, had caused France to be a country that, “regularly defected from projects on which it had initially agreed to collaborate” such as the Eurofighter, that situation changed.²²³ By the end of this millennium’s first decade, analysts estimated that approximately 30 percent of France’s DIB programs were on cooperative European projects, including the A400M transport aircraft, the Horizon-class frigate, the COBRA counter battery/missile radar, the FSAF surface-to-air naval missile, and the Tiger attack helicopter.²²⁴

As the attitude toward cooperation changed, DGA’s role began to change as well. The directorate went through a gradual process of deemphasizing its design competence and focusing more on project management. As Lazaric put it, “relational and cognitive complexity has pushed DGA to revise its traditional way of doing things and re-think its role within the defense innovation system.”²²⁵ The shift in approach has been, “to give greater autonomy to industrialists in managing the program, improving the support given by state actors to this process, while inventing original solutions for financing both the development and the buying” of defense products.²²⁶ In fact, the former giant of France’s DIB, “since 1995... has had little to say about EU restructuring and has focused on controlling costs.”²²⁷

FRANCE’S NATIONAL CHAMPIONS: THALES, DASSAULT, AND...AIRBUS

In light of France’s history as a CME, it is no surprise that its industry rationalization came long after LME Britain’s. Nonetheless, as was the case in the other DIBs, France consolidated firms, but also kept more than one national champion in line with the other CME, Italy (Leonardo and Fincantieri), despite a DIB that was similar in size to Britain’s. In France’s case, the major companies eventually distilled to Thales (electronics), Dassault (aerospace), and Airbus Group (aerospace). Unlike the other DIBs examined, France retains state-owned assets, such as majority-controlled DCNS, the country’s naval shipbuilder.

One might be surprised to see Airbus Group counted as a French firm. Airbus Group is a *societas europaea* and is headquartered in the Netherlands. Moreover, its state-ownership structure is limited to French and German government ownership of 12 percent respectively, and of Spanish government ownership of four percent.²²⁸ Nonetheless, although an overwhelming majority of Airbus Group ownership lies outside direct state ownership, the group’s state founders are still the largest shareholders and have disproportionate sway. Airbus Group represents the trend that Joana and Smith described as follows:

In analytical terms, unlike the goals of most European industrialists, the preferences of many French political and administrative actors (particularly within the DGA) had begun to change significantly from seeking to support their own national champions to throwing their weight behind a European industrial champion. Indeed, this reframing of the issue was strongly linked to a growing desire amongst many governmental stakeholders to rationalize the way arms are produced and procured in Europe.²²⁹

In addition, France and its partners in Airbus Group have become more sophisticated in applying *juste retour* so that it is no longer a straightforward arithmetic concept, but rather more of a delicate

“balance” at the level of programs as a whole.²³⁰ As with DGA’s new approach to managing programs at a higher level and permitting industry greater latitude with details, under this more market-friendly approach to *juste retour*, “its current and softer definition is left for industrialists to thrash out amongst themselves.”²³¹ France’s autonomous approach to defense product development means that it has always relied on exports to lessen per unit costs.²³² This emphasis has only increased in recent years. Export orders are key to sustaining such systems as the Rafale as well as an integral to preserving France’s DIB as a whole.

FRENCH RETRENCHMENT: ALWAYS A POSSIBILITY

France has reformed its DIB, but it has not moved far out of its corporatist policy comfort zone. Although it has used market tools to reduce its financial responsibility for defense firms and to draw on private capital and appetite for taking risk, France does not appear to have fundamentally altered its orientation toward autarky and autonomy. While it recognized the technological and market pressures that emerged clearly in the 1990s, the tension between them and France’s preferences remain. In this France is not necessarily so different from Britain, Sweden, Italy, or – for that matter – the United States. The first three countries, however, have all opted for a path that leads to much more dependence on the wider world and market. France’s primary reform, as outlined above, has been to bet on at least a degree of autonomy and scale based on the European Union, in which France retains outsized sway.²³³ In this overall context, France has not yet experienced a reaction of retrenchment to reforms taken in the last 25 years. Retrenchment may nonetheless still come. As Jane’s noted recently, “France has been willing to participate in multi-national European procurement programs (and has been a vocal advocate of intra-community industrial consolidation), but only so far as activities have benefited local interests.”²³⁴ There are two developments that could reverse an increased French willingness to embrace cooperative defense product projects. First, “analysts frequently note that France is concerned about the potential that the EU’s growing authority may conflict with national goals.”²³⁵ This could take the form of the large bloc’s now more numerous 28-country membership proving more assertive than France might want. More immediately, it could involve diverging Franco-German attitudes toward Europe, a trend seen even now over the course of France 2017 presidential election. For France, the EU has always been a means of taming Germany and, to some extent, subordinating it to Paris’ interests. In the wake of German unification, the expansion eastward of the EU, and the adoption of a euro that is managed from Frankfurt, however, France may increasingly find its interests instead subordinated to Germany’s.

Second, even under positive circumstances, it is still an open question whether cooperative European defense production efforts can succeed in the future. The European market continues to be stubbornly fragmented. Defense spending across the continent remains very low, even in the face of increased threats from the east. Whether Europeans can band together to produce first-rate, cost-effective products at scale is in doubt. As one analyst warned using fifth-generation fighters as an example:

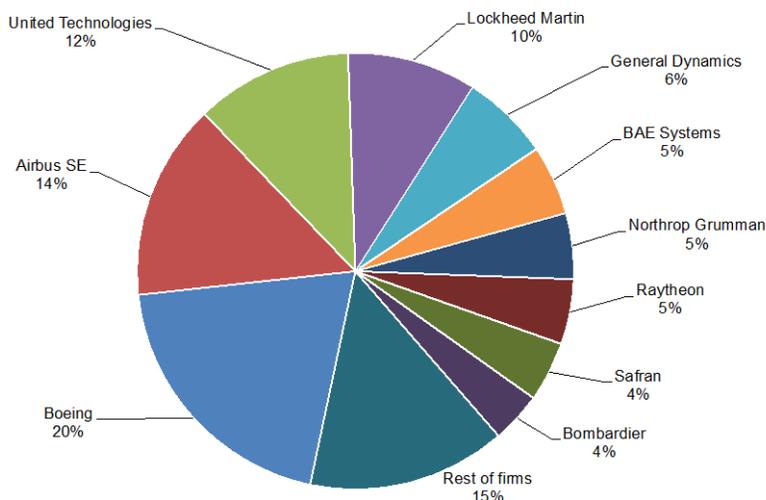
Today there is no political will in Europe to undertake this path, and even if European countries will decide to reinvest in this kind of program, the first aircraft would not be available before 2035. In sum, this option is off the table because of the choices made by major European countries back in the 1990s. Military procurement is a long-term process, therefore certain choices have to be made well before capability gaps arise.²³⁶

It very much remains to be seen whether a French reconsideration of the value of its current policy of mixing national programs with cooperative European ones could cause a retrenchment and shift in policy even greater than the one triggered in the 1990s.



Fewer Suppliers

Top Ten Firms: 85% share of Total Revenue - 2015



Unclassified

THE WEST IN SUMMARY: THE UNITED STATES

This section has considered defense-industrial relations and their evolution in the last three decades in the UK, Sweden, Italy, and France, while making occasional references to the United States. The first four countries all began from a standpoint of seeking to preserve degrees of autonomy in their acquisitions and DIBs. The argument has been that despite their distinctive characteristics – where each economy has fallen on a VoC spectrum from LME to CME – a mercilessly similar set of pressures on each became extremely clear in the 1990s. These pressures had a profound effect on government-industry relations and the DIBs of each country considered, at the same time globalization was becoming abundantly evident in other, non-defense sectors. The result has been a gradual lessening of differences and convergence among the markets, although differences of course remain.

The United States has not been immune from this dynamic. In the U.S. case, however, the scale of the economy and government resources as well as the Cold War-era size of the U.S. DIB meant that the same pressures European partners faced have been more diffuse and the country has had more room for maneuver. The pressures are nonetheless present and have had an effect no one familiar with U.S. defense affairs can deny. As technological complex and defense costs in the face on sustained budgetary pressures, this aspect of American exceptionalism seems on track to diminish.

As was the case with the UK, Sweden, Italy, and France, the U.S. DIB has gone through an intense period of consolidation, famously initiated by Secretary of Defense Les Aspin's "Last Supper" dinner meeting with defense industry CEOs to encourage them to merge in the face of declining defense budgets. The United States was not in the position of needing to privatize major industrial concerns, but the U.S. government has also sought the rigor and discipline of intensified openness to market forces, now relying for many maintenance, operations, and support services on private-sector contractors. As Markusen described, "[a]lthough the American armed forces operate many research centers, arsenals and depots, their relative significance has been smaller in the overall complex, and what remains has come under intense pressure from industry and analysts pushing for privatization."²³⁷ In structuring defense acquisitions, the United States has pursued novel approaches in attempts to adjust to face new realities.

Such was the case with the littoral combat ship program, which unsuccessfully sought to control development and per-unit costs by repurposing proven (foreign) commercial technologies and funding multiple variants from multiple vendors. The quest for budgetary and market efficiencies has been relentless, whatever the contradictions and obstacles faced in a sector where market failure is a constant challenge.

More important, for the first time there appears to be an increased recognition in the United States that defense exports are not only about alliance building and partner capacity, but also a needed avenue toward managing the extremely high costs of developing sophisticated weapon systems. The much-maligned F-35 Joint Strike Fighter program may very well be a harbinger of things to come and an experience that the United States should evaluate when developing future projects. This point is especially important in terms of national champions. Even though U.S. policy has been to preserve competition to the extent possible, the United States has slouched unintentionally toward resembling France – perhaps France before the 1990s forced it into more collaborative projects with European partners. The United States has one producer of aircraft carriers (Huntington Ingalls), one producer of submarines (General Dynamics Electric Boat), one producer of tanks (General Dynamics Land Systems), one producer of armored personnel vehicles (BAE Systems), one producer of bombers (Northrop Grumman), and, as F-15 Eagle and F-18 Super Hornet orders stand to dwindle, is on track to have one producer of fighter aircraft (Lockheed Martin).

This increasing trend toward monopoly producers, in effect national champions, has profound implications for the United States' preferred LME approach to defense-industrial relations. The ability to maintain at least the “adversarial” quality in the trio of the “rules-based, contractual, and adversarial” approaches toward the DIB could become increasingly challenged in the context of decreased competition. Absent real defense firm competition, the margin for government or firm error – in terms of expense, security, and the resilience of the remaining DIB players – decreases steeply. The United States may very well face two options, both involving activist government involvement.

On the one hand, a failure to pursue a new course may lead to the default need for a different government-industry relationship, in which the reality of increasingly monopolistic scenarios requires the government to coordinate more closely and avowedly with defense firms that understand they face no real competition. In effect, the United States would be pursuing an overall structure not unlike the one de Gaulle initiated in 1960. On the other hand, the United States could build on its LME tradition. It could take the best of the British and Swedish experiences of seeking to expand competition, efficiency, and DIB resilience by working to create a genuinely fluid, more open defense market among its allies and close partners. This policy direction would require a different kind of government-to-government coordination to identify and erode practices that contribute to the fragmentation of defense markets as well as to standardize an increasingly unified playing field on which allied and partner governments and firms could operate. Among Western and like-minded, internationalist states, the United States alone has the market-making scale and resources to catalyze such a project.

Achieving such an outcome would be challenging. As Italian officials put it, “the final result of this process will largely depend on the U.S. willingness, in their view, to establish a fair partnership, reducing barriers to entry and obstacles to the creation of a truly Transatlantic market. In their view, this will also require a multilateral framework that goes beyond the bilateral relationships the United States has established with some countries.”²³⁸ In any case, it is clear that the U.S. government will need to take an activist approach to future defense-industrial relations, whether proactively or reactively.

VI. FIRM BEHAVIOR

BAE SYSTEMS



BAE Systems Overview



BAE SYSTEMS (BAESY): 3rd Largest Global Defense Corporation

Ownership: UK Publicly Held, no foreign ownership >15% each

Government Relationship: UK National Defense Champion with £1

Special (Golden) Share with greater US market footprint

Business Segments: Structured/Organized to Governance, not

Products or Services; US, UK, European, Int'l classifications

Segment Size by Sales %Def./Com. %Air/Land/Sea

Segment	Size by Sales	%Def./Com.	%Air/Land/Sea
Electronic Sys. (US/UK)	16%	76%/24%	81%/17%/2%
Cyber & Intel. (US/UK)	9%	83%/17%	N/A-100% Cyber
Platforms & Services(US)	14%	100%/0%	2%/56%/42%
Platforms & Services(UK)	41%	100%/0%	58%/4%/38%
Platforms & Services(Int.)	20%	100%/0%	80%/7%/13%

BAE Business Conduct:

Near-Term 2018 Typhoon Production Sunset

13-15% Stake in F-35; EW; Euro. JSF MRO; JSF Missiles

37.5% MBDA JV keeps BAE relevant in European market

2014 777-X Avionics Electronic upgrade win

Hawk Trainer MRO in 18 countries with GCC and India

2015 20% stake in Reaction Engines for Hypersonic Flight

Main Strategic Issues

- Brexit implications for less European Collaboration
- £6.1B Pension Liability
- Strong US/UK concentration in extremely competitive mrkts



Typhoon manufacture and development



F-35 Lightning II design and manufacture



Unmanned and future air system capabilities



Air support and training



Defence avionics equipment



Commercial avionics equipment

16% Land		25% Maritime		54% Air	
Combat vehicles	39%	Complex warships	20%	Typhoon	32%
Munitions	19%	Submarines	27%	F-35 Lightning II	7%
Commercial	8%	US ship repair	19%	Defence avionics	18%
Weapon systems/other	34%	UK naval support	12%	Tornado	13%
		Weapon systems	11%	Commercial avionics	11%
		Other	11%	Weapon systems	8%
				Hawk	7%
				Other	4%

Business Drivers

- Positioning as MRO in Europe, South Pacific and GCC
- Embodiment of US/UK "Special Relationship"

CEO Priorities

- Maintain steady dividend increases (+2%/year)
- Maintain strong US/UK/Saudi/Australia MRO position while increasing market share in Europe and Middle East

BACKGROUND

The Post-World War II UK DIB faced unavoidable choices in the face of a plethora of companies and capacity paired with a rapidly shrinking UK and European defense market. In the 1970s, British Aerospace (BAe) was a product of prior mergers of aerospace firms.²³⁹ In 1977, the Labor government decided nationalization was the best path to maintain a level of national sovereignty by maintaining a capacity to design and build in the aerospace industry.²⁴⁰ The political winds changed when Margaret Thatcher's Conservative Party won power in 1979.²⁴¹ The result of these changes reformulated BAe as completely privatized by 1985.²⁴² Structured as a national champion but now without national protection, BAe took a path of diversification "from aerospace into other defense and civil activities."²⁴³ As with the rest of the free world, the defense industry faced challenges in the 1990s with the defeat of the Soviet Union and ending the Cold War. The West's political success in the contest between free markets and centralized power ironically most negatively affected the defense industry that made it possible.

STRUCTURE

How the United States handled its national sovereignty and DIB became another significant factor in BAe's structure. The famous 1993 "Last Supper" ushered in a series of U.S defense mergers over the next five years.²⁴⁴ The mergers of these already large defense firms put BAe at a near-permanent structural disadvantage in the United States and global defense market. With Marconi Electronic Systems (MES) on the market, which had holdings in the United States, BAe quickly switched strategies and purchased MES from GEC, forming BAE Systems.²⁴⁵ BAE capitalized on favorable exchange rates by purchasing United Defense Industries in 2005 and Armor Holdings in 2007.²⁴⁶

During this period, BAE did not abandon the European market, but reshaped its exposure in the market. BAE closed its regional jet airliner business and sold holdings of its Airbus wing manufacturing business to European Aeronautic Defence and Space Company (EADS).²⁴⁷ It also teamed with Alenia

Marconi Systems in 2001 to create MBDA, which when combined with other mergers, created a European missile production near-monopoly.²⁴⁸ By combining its domestic holdings in land armaments, with U.S., Swedish and South Africa assets, BAE became the dominant land-systems when it was already the UK's naval shipbuilding standard bearer, completing a rebalancing away from being an aerospace-centric firm.²⁴⁹ The firm nonetheless also BAE maintained a vibrant A&D portfolio based not only on MBDA, but also on a leading role in the F-35 Joint Strike Fighter program through work on the F-35 fuselage and empennage, among other aspects of the program.

BAE could historically be classified as a UK A&D firm. However, BAE at present no longer exclusively builds planes, but is also involved with a much broader spectrum of the A&D sector, particularly including electronics. After mergers that permit it to compete in the cyber domains, BAE also fits the mold of a services-oriented firm. BAE could be classified as an international defense conglomerate, but one careful to keep technology controlled under the auspices of as few governments as possible, BAE chose to maintain three nearly identical units within the group, one for the U.S market subject to ITAR provisions, one for the UK subject to their export controls and promotion and an international one to include Australian and other smaller markets. Within this framework, BAE does not have a goal of economic efficiency by platform or technology per se, but rather takes an approach of isomorphically covering of markets under each state's unique legal framework. Based on market share, BAE could be categorized as a U.S. firm just as much as it is a UK firm, while arguably also acting at times as a European business. In all this it bears a resemblance to Leonardo.

The cumulative effect of these reshaping actions was a singular firm whose global scope directed a set of independent reporting units more oriented toward the market or countries contested rather than the products offered. BAE Systems organized along five profit centers plus a headquarters activity which also had profit/loss results.²⁵⁰

Electronic Systems – with principal markets in the United States, UK, and exports;

Cyber & Intelligence – with principal markets in the United States and UK;

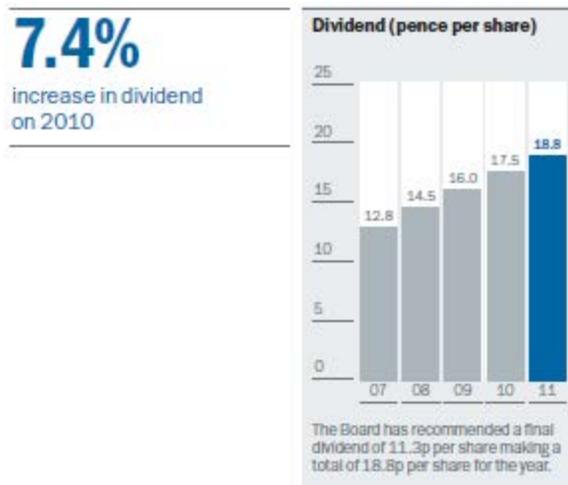
Platform & Services (U.S.) – with principal markets in the United States, UK, and exports;

Platform & Services (UK) – with principal markets in the UK and exports; and

Platform & Services (International)- with principal markets in the Middle East, Australia, and India.

CONDUCT

BAE's conduct in the global market was shaped by national sovereignty, UK political considerations, the U.S. and European markets, as well as currency valuations over the last fifteen years. Chairman Dick Olver's quote, "Agility at all levels of the group is becoming ever more important" is indicative of the challenging environment. He highlighted successes in executing the group's strategy, namely building on growing export business and established platforms plus being postured for growth in the cybersecurity market. Even with lower sales and pension liabilities, diversification and dividends were the coins-of-the-realm in BAE's maintaining an investor-grade share posture.



The 2011 BAE Annual Report²⁵¹

Despite success in terms of dividend payouts, however, BAE's global defense position fell from second to third in 2011, leaving the firm in the need of adjustments. Conversations began concerning a possible merger with seventh-place EADS.²⁵² The merger had implications beyond financial stakeholders to include government interests. The premise at stake was whether BAE, which included a UK golden share, could combine with a European champion and satisfy all the government concerns involving how the affected states could address their sovereign interests. BAE's annual report reflected extensive positive engagement with the UK, United States and Saudi Arabia, but "no agreement acceptable to all parties could be reached."²⁵³ According to a MarketLine case study on the subject, the agreement failed due to German government uneasiness about the impact to its domestic fighter market.²⁵⁴ While the UK and France were purportedly ready to make concessions, Germany could not reconcile the gains versus perceived losses.

A new Chairman, Sir Roger Carr, reoriented BAE toward a clear focus on the UK and Middle Eastern markets: "management was successful in reaching agreement in principle with the UK's Ministry of Defence on measures to enable the implementation of a restructuring of the UK naval ships business, including changes to the Queen Elizabeth-class aircraft carrier contract" and "...agreement was reached with the Kingdom of Saudi Arabia on outstanding commercial issues associated with the Typhoon order...."²⁵⁵ By 2014 data showed positive results from the strategies implemented. Although negative as expected in the U.S. market, BAE's longstanding position as Australia's largest defense contractor started to pay off with deliveries of floating helicopter docks. BAE's European position through MBDA also helped with new orders. BAE contested and won in the commercial aerospace market with next-generation integrated flight control electronics for the Boeing 777X.

Although sales decreased, the operating profit increased and backlogs only reduced slightly. The dividend kept the upward pace, but without significant share buybacks. Another strategy that seems to pay off was in the Aerospace and Marine maintenance business. In effect, BAE positioned itself for MRO work when sales of new ships and planes decreased in the United States and other markets. Fewer new planes and ships meant a greater number of older platforms required overhauls. BAE also boasted that over a third of business is from non-UK/U.S. markets, reflecting diversification into Europe (MBDA), Australia and the Middle East.



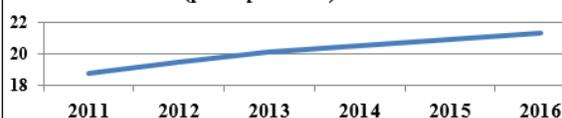
BAE Financial Performance



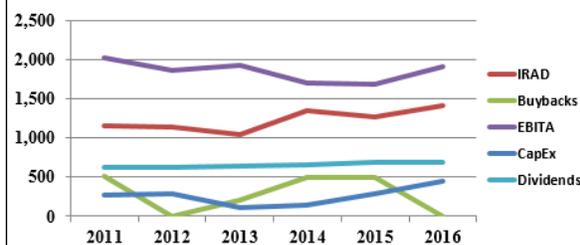
Compete across Defense Markets (Air/Land/Sea/Cyber)

- Strong aerospace position in Typhoon, F-35, MBDA JV, MRO, Hawker Trainer, Electronic Warfare, Hypersonic Engines
- 21% Sales in UK & 79% Exports (36%US, 21%Saudi, 3% Australia, 19% Other (Oman, Turkey, India, Sweden, etc.))
- 83,100 employees in 40 countries: 48,500 outside UK

Dividend (pence per share)-Coin of the Realm



EBITA, Dividends, IRAD, Stock Buybacks & CapEx (£M)



SWOT Analysis (2017 MarketLine)

Strength

- Strong emphasis on R&D
- Diversified geographic presence
- Strategically balanced portfolio/revenue streams

Weakness

- Exchange rate vulnerabilities
- Overdependence on few customers
- Unfunded retirement benefits

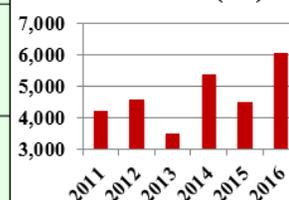
Opportunity

- Cyber security market poised to grow rapidly
- Robust growth forecasted for global missile market
- Positive outlook of the aerospace and defense sector

Threat

- Fixed price contracts & Intense Competition
- Risks (component availability, subcontractor performance and key suppliers)

Pension Deficit (£M)



PERFORMANCE

From a low point in 2012, BAE has maintained an overall positive stock price trend to the present. While some of this can be attributed to stock repurchases in the earlier timeframe, the BAE's trajectory reflects more fundamental growth and the return of larger U.S./UK defense budgets. The firm's most consistent target has been to increase dividends per share two-four percent per year, as noted above. Stock prices or past dividend payouts, however are not full reflections of future performance, so other factors must be considered. Based on more favorable employee and retiree life expectancies, historical obligations to Airbus pensioners as well as low recent interest rates, BAE has allowed pension liabilities to grow to £6.1 billion over the 2012-2016 period of performance. While not a near-term issue, over the long-term BAE may have greater difficulty funding stock buybacks, further dividends, and R&D at the same time as it works to fund retirement benefits.

BAE's future, underlying financial performance may likely also be heavily affected by the Brexit referendum and Britain's protracted process of resetting its relationship with the EU. Immediate effects were felt in currency valuation, where the pound became substantially weaker relative to the euro, dollar, and other currencies. From an export perspective in the medium term, this should help BAE, fostering an ability to compete on price alongside quality. From a defense perspective, however, the longer-term effects of Brexit could be less positive for BAE. Britain's position in NATO, already viewed by some in Europe as something of a relic of the Cold War, does not become stronger with Brexit. Brexit could mean that BAE's work to position itself as British or American remains successful, but attempting to pose as European could be increasingly difficult. On the positive side of the ledger, the firm continues to aggressively invest in R&D as well as absorb new capabilities through acquisitions. BAE benefits from UK tax credits for R&D spending, which for the firm topped £1.416B in 2016, up from £1.263B in 2015. One notable example of an R&D-oriented acquisition in 2015 BAE's purchase of a 20 percent equity share in Reaction Engines a firm focused on hypersonic engine development.²⁵⁶

SAAB



Saab Group OVERVIEW

THE SAAB GROUP

Ownership: Family Owned (Wallenberg)/Publicly Traded
Government Relationship: National Champion/Laissez Faire
Business Segments: Defense and Security

- Surveillance 26%
- **Aeronautics** 23%
- Support and Services 17%
- Industrial Products and Services 34%
- Kockums (Submarines) 26%



Saab Aeronautics Business Conduct

- Partnerships/Collaboration to Share Costs/Penetrates Markets
- Generous Offsets & Technology Transfers to Partner Nation Customers
- 25% of Revenue to IRAD to Maintain Tech Leadership

Government Relations/Influence

- Tightening Export Controls
- Acquisition Policies (Refurbish, COTS, Develop)
- Swedish Defense Spending
- Swedish Security Implications (Total Defense 2.0)

Business Drivers/CEO Priorities

- Cost Efficient Products and Solutions
- Maintain Systems Integrator Capabilities
- Penetrating Markets for Continued Growth
- Deliver on their Promises

BACKGROUND

With unrest growing and war looming in 1937, the government of the small and nonaligned Sweden recognized a need for a more robust domestic defense industry. With government support, Svenska Aeroplan AB (Saab) was formed to build military aircraft from the remnants of expelled German defense companies in partnership with the powerful Wallenberg family.²⁵⁷ Through much of its history, Saab enjoyed a cozy relationship with the Swedish government that enabled a monopoly in the domestic aviation sector, seven-year procurement agreements, and predictable income up until the 1990's.^{258,259} Tacit U.S. support in the form of technology transfer was a factor behind Saab's innovative designs as the United States perceived Sweden's position in the Baltic as important for strategic concerns vis-a-vis Russia.²⁶⁰ From bombers and fighter/attack aircraft in the 1940's, to jet powered aircraft like the Tunnan, Lanser, Draken, and Viggen through the 1980's, Saab designed and manufactured increasingly sophisticated military platforms. Overall, Sweden teamed with Saab and other Swedish industrial partners to build an advanced DIB, a world class workforce, and a secure and prosperous country.

STRUCTURE

The events following the end of the Cold War and the peace dividend resulted in major business restructurings for Saab. As the firm navigated the export markets it pursued mergers, acquisitions, and partnerships to grow and leverage the global economy. Saab divested "nonmilitary/noncore" businesses while acquiring high technology firms such as Celsius, Grintek, and Ericsson Microwave thus selecting the most productive and promising portions of the Swedish DIB.²⁶¹ Saab acquired Kockums in 2014, a submarine manufacturer in Sweden, after dramatic intervention of the Swedish government into the affairs of this foreign-owned firm.²⁶² The Saab Group is segmented into six business areas as depicted in the figure above with *Aeronautics* comprising nearly a quarter of their business.

The powerful Wallenberg family is still in effective control of Saab, with an investment share of 50 percent and Marcus Wallenberg as the firm chairman.²⁶³ It is rare for such a major defense conglomerate to be essentially under family direction, which provides advantages few publicly owned companies possess, such as the ability to seek long term opportunities versus constantly chasing short term investor demands. Despite Sweden's opening of its DIB to the rest of the world, Saab remains the

country's "national champion," particularly after having absorbed many Swedish companies in the niche markets for which this small country perceives a comparative advantage.

CONDUCT

Bjorn Hagelin remarked that in the fighter market, "Paradoxically, the aircraft seems to be the least important item in the package."²⁶⁴ Several key areas important to Saab's conduct include geopolitical differences, partnerships to exploit market share, attractive offset packages, and research and development investments to maintain an edge in product differentiation. Within the A&D market, the buyer-seller relationship has international implications. The purchase of a major defense system indicates a type of international partnership and geopolitical alliance. For instance, the Gripen is currently competing with the F-16 in a bid to supply fighter aircraft to India. Saab and Lockheed Martin each provide excellent aircraft to meet the fighter needs of this country as demonstrated by statements of various Indian officials in their 2017 video, *The Amazing Jet Fighter Race*. One Indian interlocutor described that purchasing the F-16 was more favorable due to the geopolitical ties it would ensure with the United States when she stated, "The strategic value I get from the United States is far greater than Sweden."²⁶⁵ In this world of defense exports, where geopolitics and other factors drive sales, Saab recognized the need to conduct international sales with greater savvy as discussed next.

Early in Saab's history, when the export of military aircraft was a secondary concern, the business had little concern for the complex world of international military aircraft sales. Following the restructuring of the Swedish DIB after the Cold War, the firm was relatively inexperienced in the savvy and experience needed to access international markets. Originally the Gripen project was a partnership with BAE Systems in no small part because of the UK firm's international sales experience and market penetration.²⁶⁶ Saab has also teamed with Boeing in the ongoing T-X Program competition to supply a fleet of trainer jets to the U.S. Air Force (USAF) in order to penetrate the North American market. In the fighter market such partnerships are increasingly common. These partnerships go beyond using other firms to capture lower costs and higher productivity, but also to leverage relationships that can gain access to market share. In the most recent and most heralded international sale of the Gripen, 36 aircraft for Brazil, Saab agreed to generous technical and production transfers as part of the sale. Saab hopes this partnership with Brazilian industry will open greater market share in the region.²⁶⁷ Sweden, as a small country, does not enjoy the influence of the U.S. government, so Saab as a firm must develop partnerships with buyer countries to further Gripen sales in a particularly aggressive way.

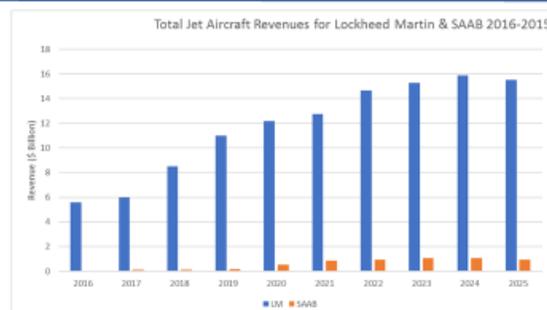
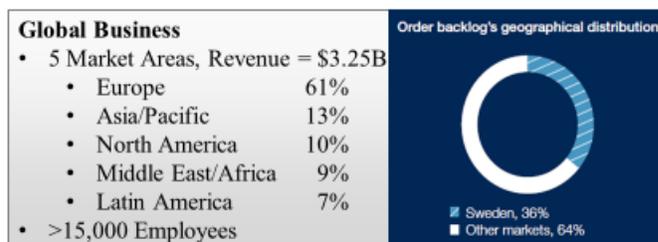
When factoring the offerings of various suppliers, customer states consider technology transfer, financing, domestic economic development, and the geopolitical concerns discussed earlier.²⁶⁸ Saab has proven particularly open to technology transfer, which is critical for customers attempting to grow their DIB. The 2014 sale of Gripens to Brazil, where Saab bested Boeing and Dassault, was won on a host of factors, not least of which was a generous offset package of indigenous production, partnering, and technology transfer.²⁶⁹ In this case, the strong offsets combined with the lower cost to operate the Gripen encouraged Brazil to select Saab as the best choice when relations with the U.S. government soured.²⁷⁰ A similar case is being made by Saab in India in its contest with Lockheed-Martin. Saab positions itself with a highly capable product that is more affordable to operate, while also promising open technical transfers and production outsourcing that competitors may not be willing or able to match. Saab's generous offset strategy may not win every competition, but it clearly provides an attractive option to developing countries.

There are many other market conduct issues with fighters, but here the focus will be on one that is particularly relevant to Saab. Many states expect to operate their aircraft for decades. A firm's ability to upgrade its products over time is an important factor. This means that R&D expenditures do not stop after production begins. Aircraft upgrades quickly become necessary in the rapidly evolving domain of airpower. Saab rises to this challenge by investing 25 percent of revenue as R&D in 2015 to sustain technological leadership.²⁷¹ In light of this persistent demand for product improvement, the Swedish NIS's strong culture of innovation and focus on the "triple helix" relationship among government, industry, and academia must be noted as one of Saab's strengths.²⁷² The flow of defense research

resources flows according to priorities set by the Swedish MOD and FMV, through the various armed forces, to universities where industry partners assist in developing technologies. This innovation system is credited with delivering constant, incremental improvements that Saab leverages for international sales.²⁷³



Saab Performance/SWOT



SWOT Analysis	
Strength <ul style="list-style-type: none"> - Poised for Growth - Strong Products/Strong Debt Position - Historically Good Relations w/Swedish Gov't - Investor Support for Long View 	Weakness <ul style="list-style-type: none"> - Uncertain Future Aero Product Portfolio - Limited Diversification Outside Defense
Opportunity <ul style="list-style-type: none"> - Jet Fighter Market Growth - Swedish Total Defense/Russia Provocations 	Threat <ul style="list-style-type: none"> - Social Democrat-Green Coalition Gov't Policies - Decreased U.S. – Swedish Cooperation



PERFORMANCE

Saab offers several aerospace systems within the Aeronautics Group beyond the Gripen jet fighter. The latest development is the Globaleye airborne surveillance system; however, sales of this developmental project are currently limited to only three aircraft to the United Arab Emirates.²⁷⁴ Saab also has a joint venture with Switzerland on the Skeldar unmanned aerial vehicle (UAV), which is a small rotary wing system for intelligence, surveillance, and reconnaissance with a reported sale to Indonesia. Although Saab divested its civilian aircraft business, it still provides support for its civilian Saab 340 and Saab 2000 models. Finally, Saab is providing some subsystem components for commercial aircraft sold by Boeing and Airbus that contribute to revenue in the Aeronautics Group.²⁷⁵ Even with these contributions, the revenues of the Saab Aeronautics Group are largely driven by the Gripen.

Sales of the Gripen and a return to profitability for the Aeronautics Group were revived with the deal to Brazil in 2014. Prior to this international sale, the bulk of Gripen revenue was driven by Swedish orders for upgrades to their aging fleet and for additional weapons integrations.²⁷⁶ As a result, employee numbers were falling and Saab endured year-after-year negative cash flow. A return to positive cash flow in Aeronautics was certainly a welcome outcome in 2016 as was the overall Group's strengthening of cash flow.

While the sale to Brazil was a windfall for Saab Aeronautics, it barely registers as market share in the overall jet fighter market. At just 2.4 percent of the market by revenue expected through 2025, Saab is dwarfed by Lockheed Martin's 52 percent market share. A Teal Group report, however, projects an interesting trend for Saab. Currently the Gripen possesses a paltry 0.3 percent of the market in 2015, yet will grow to 3.9 percent of the market in 2024, a robust 1,300 percent growth in less than a decade.²⁷⁷ If the Gripen can secure just a further one percent of the projected ten percent in competitive sales, it would represent a dramatic gain in revenue and market share for this small firm. Furthermore, if Teal Group's prediction that a number of firms will exit the fighter market by 2021, it is reasonable to expect Saab to

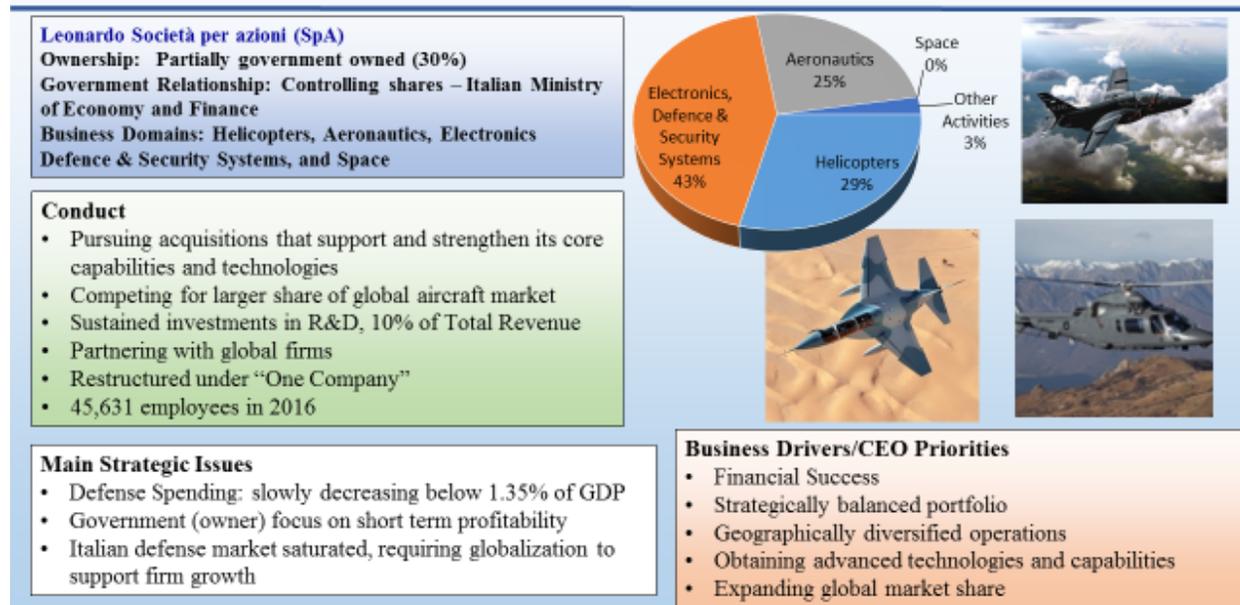
have an opportunity to gain market share in the coming decade. Saab is well-positioned marketing a modern, upgradeable, middle-tier fighter and is well poised to take advantage of growing demand.

If Saab were to secure a Gripen deal with India, profitability could soar for the Aeronautics Group as production and follow-on support would continue for many years. Even without another contract in the near term, Saab has breathing room until 2025 to secure new contracts while exploring new projects. The Brazil deal was a game changer for the firm and, along with Saab's recent agreement to sell earlier model Gripens to Bulgaria, keeps this innovative firm in the fighter market for at least another decade. The firm's partnership with the Boeing Corporation to pursue the T-X Program for U.S. trainer jets offers even longer-term potential to enable Saab's continued innovation and engagement in the fighter market. The firm's rather unique approach to international partnerships and offsets in the sale of advanced jet technology is also apt to generate more opportunities in markets where countries prioritize using fighter acquisition to grow their technical infrastructure and DIB. Nonetheless, even with the patient hand of the Wallenberg family and the Swedish government in support, the firm will be challenged to develop fifth-generation aeronautical products beyond the Gripen in order to continue to compete.

LEONARDO



Leonardo OVERVIEW



BACKGROUND

Leonardo SpA Leonardo (formerly known as Finmeccanica) is a major aircraft manufacturing firm and Italy's leading high-technology businesses. The original firm was established in 1948 to manage participation of the Italian government in the mechanical and ship-building industries.²⁷⁸ Based in Rome, the firm currently has over 45,600 employees and 218 sites worldwide, an industrial presence in Italy, the United States, the UK, and Poland, and is a significant participant in the global aerospace market.²⁷⁹ In October 2008, Finmeccanica acquired DRS Technologies, establishing a presence in the United States along with gaining access to advanced technologies in thermal imaging, power systems, and air combat training systems.²⁸⁰

STRUCTURE

Within Italy, Leonardo operates as a monopoly in its core business domains: 1) helicopters, 2) aeronautics, 3) electronics, defense and security systems, and 4) space. Although it has one primary domestic customer (the Italian government, including military and civilian products), it is also a major exporter of defense equipment, primarily military helicopters and fixed-wing jet trainer aircraft.²⁸¹ There are high barriers to competition within the Italian defense market, which is described as being “one of the more imperfect defense markets in Europe” due to its opaque and politically-driven acquisition system.²⁸² However, the domestic market alone is not large enough to fully support the Italian DIB which is built around Leonardo, leading the firm to continue to expand its participation in global markets.

A good characterization of how Leonardo conducts business is the “triple identity” model: be Italian, European, or global according to competitive needs. This has enabled the firm to overcome barriers to entry in other regions and countries, such as: 1) participation in the U.S. F-35 program, 2) partnership with BAE (through DRS Technologies) on BAE's Common Missile Warning System, and 3) cooperation with the Polish Armaments Group (PGZ) on helicopter production for the Polish Armed Forces.²⁸³ Leonardo went through significant restructuring in 2016 to better align the subsidiary companies within the group. This restructuring culminated in the replacement of the CEO Mauro Moretti

by Alessandro Profumo, a banking executive in March 2017.²⁸⁴ Moretti, appointed as CEO of Finmeccanica SpA in April 2014, is credited with rejuvenating the firm after several years of corruption, mismanagement, and lack of vision. Moretti was responsible for implementing the one company vision, absorbing all of the Italian subsidiaries into corporate divisions under centralized management and core business sectors, and renaming the firm Leonardo in April 2016.²⁸⁵

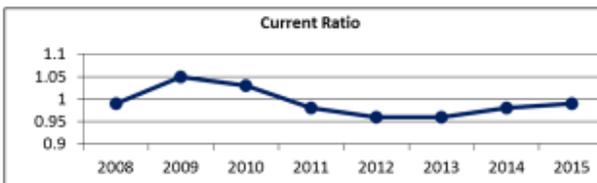
The Italian DIB is the fourth largest in Europe (in terms of defense spending), and can be described as a pyramid. At the highest level, Leonardo is the dominant firm with 68 percent share of Italian aerospace and defense firm revenues. The second largest firm is Fincantieri (shipbuilding) with 20 percent share. The firms act as prime contractors in domestic and foreign markets, civilian and military markets, and as partners or subcontractors with other European and American firms.²⁸⁶ In determining the “health” of the Italian DIB, it is important to consider the impact of government ownership and priorities in decision-making on foreign policy and investments in technology. The Italian Ministry of Economy and Finance owns controlling shares in both Leonardo (30 percent) and Fincantieri (72 percent), with the power to establish rules to be followed by investors (domestic and foreign), including the power cancel decisions made by Italian DIB companies if they are deemed conflict with national security interests, and to veto the acquisition of companies’ stocks by certain investors.

Historically, these would have been indications of poor health for the DIB. However, in the changing environment of globalization, both Leonardo and Fincantieri have managed to diversify into the global markets, each earning over 80 percent of total revenues from outside Italy. The effect of this has been to allow both companies to establish industrial capabilities in other countries, provide additional growth opportunities beyond the limited demand of Italian military forces, and to access advanced technologies and innovations in aerospace and defense industries. Therefore, any valid definition for “health” in the context of the Italian DIB (and to some extent the European DIB) must consider exports, mergers and acquisitions in other countries, partnerships, joint ventures, and collaborations with the leading and successful firms competing in the global environment. The threat of new entrants to the globalized DIB is greater, however. New and emerging defense firms are competing in supporting global supply chain and maintenance, repair, and overhaul (MRO) services, using those venues for obtaining higher technologies and advancing their capabilities in precisely the niches Leonardo has targeted.

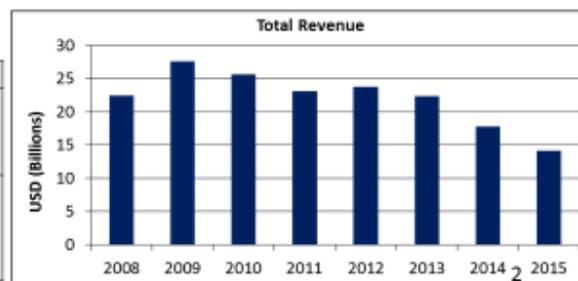


Performance/SWOT

Global Business
<ul style="list-style-type: none"> • 83.8% revenue from other countries in 2015 • Industrial presence in U.S., UK, and Poland • Leonardo DRS, wholly-owned subsidiary in U.S. • Joint Venture with Russia on Superjet Program



SWOT Analysis	
Strengths -Balanced yet diversified portfolio -Strong focus on R&D -Gov't support	Weaknesses -Controlled by Italian Ministry of Economics and Finance -Corporate focus on near-term success
Opportunities -Global UAV market -Robust backlog of orders/new contracts -Advanced jet trainer aircraft market	Threats -Stringent environmental regulations -Italian gov't tends to appoint CEOs with no aircraft experience to lead the company



CONDUCT

In early 2000s, Finmeccanica abandoned a strategy of taking part in European-wide consolidation of the defense industry and instead pursued global sector alliances. The primary reason for changing strategies was the European sector's inefficient processes and sluggish decision-making, exacerbated by the limited resources available as compared to global resources. This scarcity of resources compounded the competition and resulted in an unviable market environment. The slow evolution of globalized markets over the years have lead us to the current global market structures which appear to be more robust in comparison. It has taken many years, but Leonardo is now finding the right corporate structure for making its new strategy successful; it deconflicted its core business domains, identified a viable selection of diverse portfolios for supporting those domains, divested non-aligned portfolios and business interests, and implemented corporate strategies that for aggressively competing in global markets consistent with its core domains.

Over the past ten years, Leonardo has actively pursued acquisitions that support and strengthen its core capabilities and technologies for aerospace, electronics, and security system sectors within the Italian, European, and global DIB. Leonardo's objectives include expanding its share of the global market and competing globally across all of its business domains. Recent corporate decisions and policies have been consistent with those objectives, including the replacement of Moretti with Profumo as CEO. Policies include: 1) investments in R&D, 2) new acquisitions for advancing their technological capabilities (e.g. Daylight Solutions, bolstering Leonardo's existing core business of electro-optical and infrared sensors and systems), and 3) partnering with larger firms (e.g. partnering with Boeing on its bid for the UH-1 Huey replacement).

The acquisition of DRS Technologies in 2008 provided Leonardo a strong presence in the United States and other global markets (UK, Canada, Germany, and Saudi Arabia), and gave it access to a broad range of advanced technologies including radar systems, multi-domain awareness, night vision systems, and unmanned systems.²⁸⁷ Although this acquisition has been criticized over the years due to poor financial performance, Leonardo's 2016 Annual Financial Report included positive assessments of DRS' performance. DRS has undergone organizational changes over recent years, including a reduction of its number of employees from 10,000 to 5,500 in order to focus on core domains. These cost-cutting measures, similar to Leonardo's transition to one company, appear to be successful and DRS now appears much more central to Leonardo's global strategy and is playing a prominent role in a push forward in the United States and other global markets. This new position in Leonardo's business strategy is most apparent in the role of Leonardo DRS in its bid for the T-X Program, especially after the disintegration of the firm's collaboration on the project with U.S. partner Raytheon in January 2017. The firm has not backed down from competition, for example pursuing a legal challenge to Canada's decision in February 2017 to award Airbus the contract for the fixed-wing search-and-rescue aircraft program.²⁸⁸

Leonardo is also looking to the Asia-Pacific. The firm has already demonstrated its ability to compete in the global market while continuing to meet the demands of the Italian DIB. The firm suffered a major setback in India involving corruption allegations in 2013 which lead to the imprisonment of former Leonardo (then Finmeccanica) CEO Giuseppe Orsi in 2016, and is working hard to address that negative fallout to its corporate reputation. The firm is pushing the AW-101 as a viable candidate for the India's naval multi-role helicopter competition and is focusing on military and civilian helicopters for the broader Asia-Pacific market. Other aeronautics portfolios in Leonardo will have a stronger chance to compete successfully in the region after Leonardo establishes a solid presence in the helicopter market and demonstrates the capabilities required for delivering quality products at competitive prices.²⁸⁹

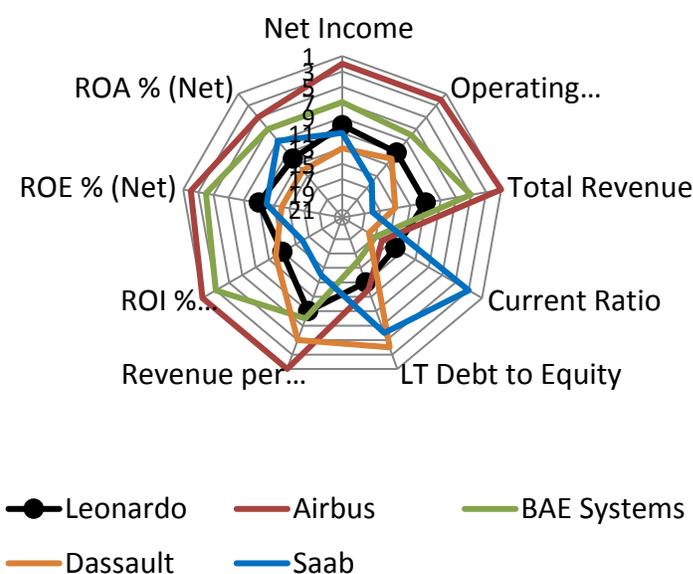
Annually, Leonardo tends to invest ten percent of its revenues in R&D, collaborating with universities, institutes, and research organizations in Italy and around the world.²⁹⁰ With declining revenues over the past six years, however, actual investments in R&D have been reduced. Leonardo and Polytechnic University of Milan created "InnovationHub" for promoting cooperation between industry and academia in research, development and innovation.²⁹¹ Currently, numerous university research projects related to Leonardo's business areas are underway.

The role of the Italian government is an important consideration in any analysis of Leonardo and its role in the global market as it provides a different level of sponsorship. The Italian Ministry of Economy and Finance (MEF) owns 30 percent of Leonardo, yet Italy's defense business is conducted through the Ministry of Defense.²⁹² This complicated arrangement has positive and negative effects on the defense industry, with government ownership providing the basis for Leonardo's current focus on "financial success".²⁹³ This control was demonstrated in 2014 when the MEF appointed Mauro Moretti CEO of Finmeccanica, with the mandate to clean up the many issues impeding financial success (e.g., corruption scandals and lack of corporate oversight in general),²⁹⁴ and then replacing Moretti in March 2017 with a banking executive.²⁹⁵

PERFORMANCE

The performance of Leonardo is assessed here at the firm and industry levels, in the context of the global market. This assessment examines the firm's total revenue, long-term debt to equity ratio, and return on investment (ROI), along with other metrics including revenue per employee, operating income, net income, cash flow from operations, and current ratio. Leonardo's performance over the past 18 years has been very consistent with the other middle-ranked firms. It is also worth noting that although total revenue for Leonardo has been slowly declining since 2008, the effects of recent restructuring (organizational and leadership) will develop over the next year or two and so remain to be seen. The outlook published by the former CEO, Mauro Maretti (in March 2017, prior to his being replaced), paints an optimistic picture of development and growth.²⁹⁶ The figure below provides a radar plot comparing Leonardo's global ranking in 2015 to the European aerospace competition: Airbus, BAE Systems, Dassault, and Saab. Firms were ranked separately in nine categories for financial performance, with results plotted and compared. From the figure it is observed that although Leonardo did not rank high in any single category, it did rank consistently in the middle across all categories. The categories included in the plot are: 1) net income, 2) operating income, 3) total revenue, 4) current ratio, 5) long-term debt to equity ratio, 6) revenue per employee, 7) ROI, 8) return on equity (ROE), and 9) return on assets (ROA). When considering the historic and current metrics, Leonardo is a fundamentally sound and healthy firm.

2015 Global Ranking of European Aircraft Firms



DASSAULT



Dassault Overview



Privately Owned

- Groupe Industriel Marcel Dassault (56.1%)
- Airbus Group (9%)
- Remaining shares held directly by Dassault or as free float

Government “influence” and indirect “Golden Share”



Business Conduct - 100 years of “Company DNA”

- 2016 “most attractive French company”
- 2017 “best employer in France”
- March 2017 “Leading our Future” transformation plan
 - Launch of new Falcon model
 - Increase markets shares = flexibility and cost reductions
 - Reorganization and consolidation of industrial sites

Business Drivers

- “National Champion” = secure future
- French monopoly...export dependent
- Indigenous future fighter production questionable
- Emerging UAS interest = Dassault facing “defining moment”
- Volatile business jet market

Strategic Issues

- Shift towards int’l collaboration in UAS development
- Shift away from indigenous suppliers
 - “National Autonomy” to “Strategic Autonomy”
- Continued emphasis on “ITAR-free” exports

Unclassified
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BACKGROUND

Dassault Aviation S.A. (Dassault), which can trace its roots back to 1916, is a multinational aeronautical firm that designs, manufactures, and supports combat aircraft and business jets. It currently markets business jets through the brand name Falcon, military aircraft through Rafale and MIRAGE, and military drones through nEUROn. Dassault also develops space transportation systems, micro launchers, and space vehicles.²⁹⁷ The Firm’s activities are centered on:

- Aeronautics with more than 2,400 Falcon jets and 1,000 combat aircraft in 88 countries, with over 17 million flight-hours,
- Space Activities (ground telemetry systems, spacecraft design and pyrotechnic activities),
- Services (Dassault Procurement Services, Dassault Falcon Jet, and Dassault Falcon Service), and
- Aerospace and Defense Systems (Sogitec Industries).²⁹⁸

Dassault is owned by the Groupe Industriel Marcel Dassault (56.1 percent) and Airbus Group (9 percent) with remaining shares held directly by Dassault or as a free float. It is noteworthy that the Airbus holding fell from 46 percent to nine percent between 2014 and 2016. It should also be noted that Dassault holds 26 percent of the much larger Thales Group.²⁹⁹ Dassault is headquartered in Paris and employs about 11,745 people, 9,189 of who are based in France (2015).³⁰⁰ Geographically; Dassault operates in export markets and France. In FY2016, export markets accounted for 92 percent of the Firm’s total revenue and 17 percent of France’s total revenue.³⁰¹

Dassault carries out R&D activities to advance green aviation. It funds innovative technologies such as integrated systems, advanced composites, and aerodynamics. It also participates in French and European aeronautical research programs, which includes management of the Cleansky 2 research program, Single European Sky Air Traffic Management Research program, Alfa-Bird (alternative fuels) program, Hypathie project (connections between aviation and increased cloud cover), and Solar Impulse (first fuel-free flight around the world).³⁰²

STRUCTURE

The Firm has two principal business units: Dassault Aviation Falcon division and Dassault Aviation Defense division. It also has a minor space interest.³⁰³ The Falcon division develops and produces the Falcon line of civil business jet aircraft, but it also undertakes some work on behalf of the group's Defense division, with a range of military multi-mission aircraft based on the Falcon jet. The business is formed of Dassault Falcon Jet USA, Dassault Falcon Services France, and Dassault Procurement Services USA.³⁰⁴

The defense division focuses on Mirage 2000 sustainment and Rafale fighter aircraft production and support. It also has an input into the nEUROn unmanned aerial vehicle development program with Alenia, Saab, Airbus, Hellenic Aerospace Industry, and RUAG. Dassault also develops space vehicles, rocket propulsion, and ground-based space vehicle telemetry. The defense division is organized into two sub-units. The International General Directorate is in charge of canvassing, promoting, and selling Dassault's military aircraft outside of France. The Military Customer Support Division is responsible for defining combat aircraft operating and maintenance concepts and associated products and services. It is also in charge of promoting and selling logistic support services and after-sales services.³⁰⁵

Within France, Dassault enjoys a monopoly. In 1965 and 1966, the French government “specialized” its defense primes in order to maintain viable companies. Dassault was specialized in combat and business aircraft, Nord Aviation in ballistic missiles, and Sud Aviation civil and military transport aircraft and helicopters (later becoming Airbus through a series of mergers). Consequently, Dassault remains France’s “national champion” for combat and business aircraft.

Internationally, however, Dassault faces fierce competition, especially in the high-end fighter export market where Dassault’s only current offering is the Rafale multirole fighter. International interest in the Rafale has been faint from the beginning. Early in the program, the firm aggressively courted other governments and industry in the hope of attracting additional investment and cost-sharing in the Rafale’s development program, without success.³⁰⁶ After 25 years of fighter aircraft export competition failure, the firm had essentially put Rafale production on a shallow glideslope towards termination. However, recent “surprise” Rafale orders from Egypt (2015 for 24 aircraft), Qatar (2015 for 24 aircraft), and India (2016 for 36 aircraft) have made the Rafale relevant again and extended its production run at least through 2025.³⁰⁷

The relative failure of the Rafale in the export market coupled with intensifying international rivalry fueled by global commonality and interoperability requirements leaves the future of indigenous French fighter production in question. “The French defense industry should enjoy the Rafale program while it lasts. It will probably be the last vertically integrated French fighter, and the next French combat aircraft could be a joint European effort – truly a shotgun marriage. An even greater break with recent decades would be if France finds itself with an F-35 variant.”³⁰⁸ Conversely, the Falcon family is highly competitive in the high-end business jet market. It is a sign of the times that business jets, once an afterthought to Dassault’s primary business area, saved the firm from being marginalized. Falcon will likely remain the firm’s strongest bargaining chip in any future industry restructuring.³⁰⁹

Dassault’s future nonetheless appears relatively secure. As noted, the firm is France’s “national champion” for combat and business aircraft. The French state retains significant holdings - or “golden shares” – in the country’s largest defense and aerospace concerns and can be viewed as an active shareholder – going as far as orchestrating mergers and acquisitions between major participants.³¹⁰ Most European countries are prepared to abandon fighter self-sufficiency, although France can be expected to hold onto the capability as long as possible. Rafale will be the last of the European planes to end production, probably around 2024 for domestic production. Exports may keep it going until 2030. But France took a step away from fighters in early 2006 when it closed the Mirage 2000 line. Even with UAVs and other palliative programs, this will be a difficult and defining moment for France and its aerospace industry.”³¹¹

CONDUCT

In 2016, Dassault celebrated its centennial, which presented an opportunity for the firm to reaffirm its core principles: passion for aeronautics, civil and military duality, search for technological innovation, sound management to ensure the financial health of the firm while investing in the future, family shareholding and spirit, teamwork, responsiveness and tenacity, not forgetting an element of luck - symbolized by the clover in Dassault Aviation logo.³¹² Dassault – and its values – were recognized by the 2016 Randstad Award as the most attractive French firm for all categories combined, and as the best overall employer in France in early 2017.³¹³ Despite these accolades, Dassault will also recall 2016 for the global economic and geopolitical uncertainty that plagued the business aviation market, which had already been difficult in 2015, against an increasingly gloomy and fierce price-war backdrop. The firm's leadership has recognized the challenge and is preparing for a future in an increasingly competitive environment.³¹⁴ Eric Trappier, chairman and CEO, in March 2017, he announced a transformation plan called "Leading our Future" that will contribute to the launch of a new Falcon model and allow Dassault to increase markets shares, particularly by increasing flexibility and by reducing costs in a competitive environment. The plan also includes a significant reorganization of Dassault's nine industrial sites in order to consolidate like-manufacturing processes and "specialize" sites in the production of Falcon and Rafale components.³¹⁵ Trappier's outlook and strategy for 2017 includes these key objectives:

- sell Falcon aircraft and obtain new Rafale export contracts,
- further execution of the Rafale contract with India, and implement the offset contract notably through the Joint-Venture in India,
- ensure the SilverCrest engine program keeps on track in accordance with the new schedule, on which the Falcon 5X schedule depends,
- reinforce France's roadmap for Rafale and drones,
- define the technological "building blocks" for the future Falcon, and establish the conditions to launch a new Falcon, according to the results of a market survey,
- ensure the Firm's transformation in order to, in particular, improve industrial tools and competitiveness, and
- meet delivery goals: 45 Falcon and 9 Rafale.³¹⁶

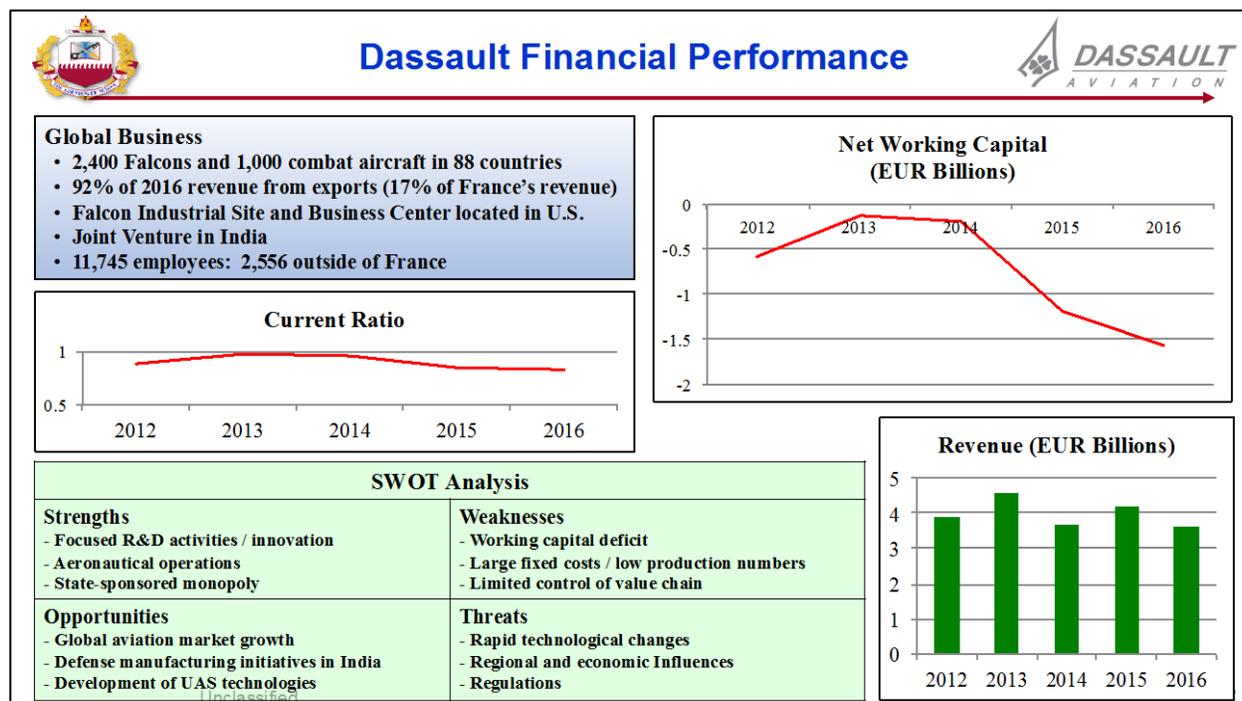
Concurrently, Dassault is stepping up R&D on drones with:

- new flight test program for the nEUROn unmanned fighter aircraft, dedicated to stealth demonstrations, as well as tests at sea with the Charles de Gaulle aircraft carrier,
- a proposal to launch at the end of 2017 the first development phase of an operational UAV demonstrator, one of the components of the Future Combat Aircraft System.
- The launching by the Organization for Joint Armament Cooperation, in conjunction with the French, German, Italian, and Spanish defense ministries, of a two-year definition study for a Medium Altitude Long Endurance - Remotely Piloted Aircraft System (MALE-RPAS) drone using European technologies. This study brings together Dassault Aviation, Airbus Defense and Space, and Leonardo.³¹⁷
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Finally, in 2016, Dassault also announced the creation of a joint venture with Reliance Group of India to manage offsets related to the Indian contract for 36 Rafales, and in February 2017, Dassault Reliance Aerospace Limited was created.³¹⁸

Interestingly, unlike most of France's major defense primes, Dassault, is no longer state owned; however, the complex web of shareholdings can restrict the firm's autonomy, while giving it an effective veto over a rival's plans. In the case of Dassault, a privately owned firm, it holds sway over both Thales (it holds 25 percent of the firm) and, therefore, shipbuilder DCNS (in which Thales holds a 35 percent stake), but is yet subject to the same threat by Airbus' minority blocking stake in the firm (Airbus holds nine percent of Dassault). With such a web of private ownership, state investment and publicly traded

shares, the French defense industry faces a tougher challenge than most when trying to change.³¹⁹ Dassault has been “uniquely” unobstructed by the myriad of acquisitions, mergers, and consolidations that have reshaped the aerospace industry over the past few decades. The firm faces significant challenges common to the aerospace industry, but also enjoys the general autonomy of a privately owned enterprise while basking in the security of a government-directed monopoly.



PERFORMANCE

Dassault is savoring its recent – and still surprising – export sales of Rafale. This will extend the production line at least through 2025, and maybe as long as 2030. This is not only good for Dassault, but it will also give the French government an LPM funding break by keeping the Rafale line open while deferring production of domestic Rafales. With Rafale orders up, the firm is able to focus on its more urgent challenge; slowing of Falcon orders. Total Falcon deliveries in 2016 were down 11 percent from 2015 and orders were down 16 percent for the same period. For decades, Dassault Falcon has been the big winner for the firm's bottom line, and as noted, it will possibly outlive Dassault Defense, as it exists today. However, in a very timely twist of fate, Rafale sales – and other Dassault Defense activities – have boomed just when the firm needed it most. Overall, Dassault reported a 14 percent decrease in sales revenue since 2015 (EUR3.6 billion in 2015 versus EUR4.2 billion in 2016).³²⁰ The overall trends are not in a positive direction; however, as noted, Dassault has just recently put a “get well” transition, reorganization, and consolidation plan into place. It is too soon to tell if Trappier's strategy will be successful.

AIRBUS



AIRBUS OVERVIEW

Airbus	
Ownership: 73% Public +11% France, 11% Germany, 4% Spain	
Government Relationship: Increased CEO Autonomy since 2012	
Business Segments:	
✈ Commercial Airplanes	73%
✈ Defense & Space	18%
✈ Helicopter	9%
• Civil	55%
• Military	45%
Airbus Conduct	
<ul style="list-style-type: none"> • Strengthen market position and profitability • Preserve lead in European defense and space • Innovation: Incremental and disruptive • Build global presence • Increase services • Strengthen value chain position 	
Main Strategic Issues	
<ul style="list-style-type: none"> • Reduced defense spending • Program complexity (A400M, A320neo, A350XWB) • “Competition law” (limiting BAE merger) • Government management of work-share 	

**Business Drivers/CEO Priorities**

- Consolidate & Focus: “Airbus is a commercial aircraft maker” with defense and helicopter divisions
- Deliver on high visibility programs
- Ensure incremental innovation for ops excellence
- Establish a culture for long-term disruptive innovation to avoid strategic surprise

BACKGROUND

“2017 Way Forward: Airbus is a commercial aircraft maker with two divisions, ‘helicopters’ and ‘defence and space.’³²¹ This proclamation, consuming an entire page and printed in “bold caps” in the very recently released annual report might seem simple. It is actually a profound statement declaring that the firm, and perhaps more broadly Europe, has finally arrived at the end of a multi-decade consolidation. As the annual report notes, 2017 is the year that, “as a result of the re-labelling to a single Airbus brand, the firm together with its subsidiaries will be referred to as ‘Airbus’ and no longer the ‘Group.’”³²²

Airbus Industry began as a government initiative in 1970 through a collaboration between the UK, France, and Germany. Spain joined a year later. The partner companies were Aerospatiale (France: 37.9 percent), Deutsche Airbus (Germany: 37.9 percent), British Aerospace (20 percent) and Construcciones Aeronáuticas SA CASA (Spain: 4.2 percent), and with government financing came significant oversight. The end of the Cold War led to significant reductions in defense expenditures going from two-four percent of GDP to 1.0-2.5 percent of GDP. These reductions in spending were accompanied by the ever-increasing complexity of exquisite systems weapons systems with an associated increase in cost.³²³ To ensure the critical number of engineers to support development and the threshold of financial resources to invest in development, consolidation became essential. As Meijer noted, “technological and industrial trends are blurring the distinction between defense and other industries, such as electronics, information technology and space facilities.”³²⁴ This creates greater ability to link defense and non-defense companies through technology sharing and makes consolidation even more attractive, by reducing overhead of corporate governance and sharing key capabilities between business units. Over the course of the 1990s Europe consolidated from 16 to five A&D firms.³²⁵ By 10 July 2000, European Aeronautic Defence and Space (EADS) was born based on the merger of Aérospatiale-Matra, Daimler Chrysler Aerospace AG (DASA), and CASA.

STRUCTURE

The role of European governmental stakeholders has been an inherent aspect of Airbus’ structure and evolution. It has not been until Tom Enders’ tenure that the role of government has begun to diminish in a meaningful way. When he became CEO in June 2012, Airbus was EADS. Under his leadership, a

series of changes have reduced the political influence of France, Germany, and Spain, which together own 26 percent of the stock. He has also presided over a closer integration of the Airbus corporate structure and workforce, creating what he calls a “truly European firm.”³²⁶ For years, Airbus has lived with the difficult challenge of disentangling the various interests of the government entities while trying to make effective corporate decisions. Enders has made some of the most significant progress in this regard by gaining additional autonomy after the merger with BAE was denied.³²⁷ That said, defense spending by European governments still provides significant leverage over the future of Airbus and has driven Airbus strategy to focus on only those defense projects that receive full funding from the government from the outset. Many military programs have been problematic for Airbus (e.g. A400M challenges, a lost tanker sale, and problems with Eurofighter upgrades). Given these difficulties, it is highly unlikely that Airbus under the current paradigm will provide the leadership or capital necessary for deep long-term and independent investment into the European DIB.

Following the failure of its merger with the British group BAE Systems at the end of 2012, a major internal reorganization process ensued: governance reform and structural change of shareholders, adoption of the name “Airbus Group,” strategic review, and restructuring of activities in three main lines (Airbus, Airbus Helicopters and Airbus Defense & Space, the latter including Airbus Military, Cassidian and Astrium). The stated intent of the EADS-BAE merger was based less on segment-level consolidation and more on the desire to create a balanced commercial aerospace and defense portfolio, thereby providing a more stable platform in aggregate than a purely commercial or defense player could achieve alone.

The reorganization and rebranding of EADS under the Airbus name reflected three core realities. First, EADS has failed to gain significant traction as a brand since its formation. Second, the EADS brand was viewed as an essentially European public project and has been tarnished by the in-fighting of stakeholder states. The rebrand may therefore reflect ongoing efforts to break with the past. Third, there was a widening gulf between the fortunes of the military and commercial interests of the group. Airbus commercial revenues climbed from €7 billion in 2010 to €6 billion in 2012 year. Over the same period, Airbus Military sales fell by €800 million to €1.8 billion. Other issues were the ongoing need to balance the interests of the French and German states, which dominated the EADS board with a 24 percent combined holding in 2014, while finding a safe haven for EADS’s military interests (particularly Cassidian) during a turbulent time for defense markets. It was also the need to secure Cassidian (where the Typhoon program is managed from via the Eurofighter consortium) that was a key driver for EADS in the aborted attempt to merge with BAE Systems of the UK in 2012.

While the consolidation of the Airbus Group into Airbus can create efficiencies in corporate governance, it is also a sign of the firm’s lack of confidence in the “defense hedge.” In fact, the 2016 annual report explicitly states, “defence can no longer be a tool to manage and hedge against commercial cycles.”³²⁸ This leaves some uncertainty about the level of commitment of the now consolidated Airbus to the broader European DIB.

CONDUCT

In 2013, after the BAE merger failed, Enders introduced a strategy that continues to be the core strategy of Airbus moving forward. He explained, “our first and most important priority is to successfully manage the ramp-up in commercial aircraft.”³²⁹ The overall firm strategy is outlined in the following eight strategic paths:³³⁰

1. Strengthen market position and profitability while remaining a leader in commercial aeronautics.
2. Preserve leading position in European defense, space, and government markets by focusing on military aircraft, missiles, space and services.
3. Pursue incremental innovation potential within product programs while fostering and pioneering disruptions in the industry, and developing necessary skills and competencies required to compete in the future.
4. Exploit digitalization to enhance current business as well as pursue disruptive business model.

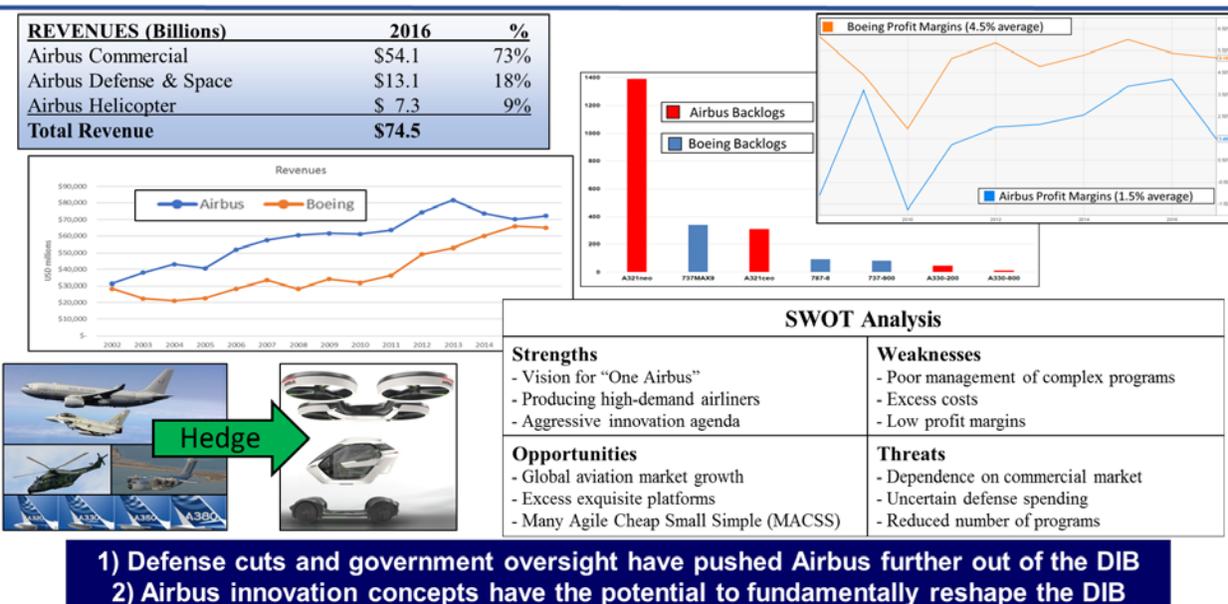
5. Adapt to a more global world as well as attract and retain global talent.
6. Focus services on and around the Group's platforms.
7. Strengthen the value chain position.
8. Focus on profitability, value creation and market position--no need to chase growth at any cost.

It seems clear that Airbus has made the decision to intensify an emphasis on the commercial sector, services, and the Asian market. The focus is on establishing operational excellence to maximize near-term profits while establishing a hedge for the future with a robust Chief Technologist Office that seeks opportunities at incremental as well as disruptive innovation. This creates an opportunity to compete on cost in the near-term and the potential ability to compete on differentiation in the long-term. When looking at when to compete it seems that Airbus has gone into a position to take the first mover role, both in the near-term and long term competitions. Using the A320neo, Airbus has been able to establish itself as a first mover in the high-efficiency single-aisle market. The success of this strategy has shown itself in an overwhelming lead in orders. With over 75 percent of the backlog and almost 80 percent of revenues coming from outside Europe, Airbus is, more than ever, a global firm.³³¹ One of the most important markets for Airbus in the near-future is the rapidly growing Asian market. In recent years, China and India have emerged as significant new aircraft markets. According to Airbus estimates, the two are expected to constitute the first and fifth most important markets by aircraft delivery value, respectively, in the next twenty years.³³² By 2016, Airbus had 1,300 aircraft operating in China, which is the home of the first Airbus manufacturing line outside of Europe, as well as multiple customer support centers.³³³

With regard to capacity, part of the new product development strategies of Airbus includes divestments in specific areas which are not core or low value according to their systems integration business strategy. Airbus divested a significant number of assets and related capabilities in 2000s, reflecting its interest in consolidating around specific domains after the establishment of EADS as a standalone firm. Divestments in commercial aircraft segments were mostly performed in segments that were considered low value-added. In 2007, Airbus put seven production sites up for sale particularly producing parts and aero-structure components for its commercial aircraft programs including those that are responsible for producing parts for the new A350. The firm managed to sell only two of them in the time of global financial crisis and it decided to reorganize remaining sites around two big aero-structures subsidiaries, one in France and the other one in Germany.

Broadly speaking, one of the major differences between Boeing and Airbus is the geographical distribution of their knowledge and production bases. Compared to Airbus's much more active strategy of positioning itself internationally through acquisitions and divestments as well as investments beyond its European base, Boeing's investment strategy is largely restricted to the United States while it relies on international outsourcing. Even in its latest and most outsourced program, Airbus still keeps important components manufacturing adjacent to its final assembly.

AIRBUS AIRBUS PERFORMANCE



PERFORMANCE

In 2016, the value of the Airbus commercial market share accounted for 54 percent of the gross worldwide total. Airbus Commercial Aircraft recorded total revenues of €49.23 billion, representing 73 percent of Airbus' revenues. In Airbus Helicopters recorded total revenues of €6.65 billion, representing nine percent of Airbus' revenues with civil contracts accounting for 55 percent of this order volume, and military sales representing the remaining 45 percent. Finally, Airbus Defence and Space recorded total revenues of €11.85 billion, representing 18 percent of Airbus' revenues. This section will review performance metrics over the last five years to identify trends.³³⁴

In the first quarter of 2017, Airbus earnings fell 52 percent based on engine delays on the A320neo, production delays on the A350, and ongoing concerns that the A400M cost, schedule and performance challenges are going to continue in to 2018.³³⁵ While this quarterly earnings report is just a snapshot in time, profitability has been an ongoing challenge for Airbus. Comparing the profitability of Airbus and Boeing, one finds that Airbus over the last five years has generated profit margins of around 1.5 percent while Boeing's margins have been about 4.5 percent. The revenues of both firms have grown at a comparable rate during the period, but Airbus revenues have consistently exceeded Boeing's, confirming that Airbus products are highly competitive. This particular point speaks to the ability of Airbus to secure orders and deliver, but only at costs that are too high. The Airbus strategy of further consolidation and focusing on commercial sales is aimed at reducing costs over time. Also, Airbus' return on equity has been lower over the long-term when compared to Boeing's and the rest of the sector. Quite simply, Airbus does not use the money it invests as efficiently as Boeing.

Over the last five years beginning with the failed BAE merger, Airbus has recognized that there are going to be limited defense budgets and has responded by focusing on the commercial sector. This last year saw that position begin to come to fruition from a structural perspective and shows how the government has influenced firm strategy. It appears that this government-industry interaction is going to undermine the European DIB, making it less capable of equipping Europe to counter near-peers or even be effective in lower-end conflict. In lieu of a coherent government-led defense industrial strategy, Airbus has chosen to take advantage of less government oversight to work on increasing profitability. Whether intentional or not, this dynamic could dramatically restructure the DIB by creating a hedge to the highly complex and inordinately expensive exquisite platforms and in the end increasing military capability,

flexibility, efficiency, and surge capacity. With a vision to avoid strategic surprise, Enders has invested human, financial, reputational capital into this hedge strategy by very explicitly looking for the next generation of aerospace and defense technologies. It seems that many of these commercial technologies could be used for defense purposes, increasing capability, flexibility and affordability.

BOEING

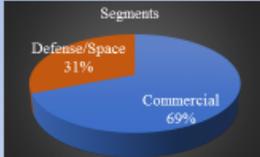


The **BOEING** Company (BA)

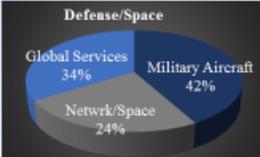


Ownership: Publicly Held/Traded
Government Relationship: Laissez Faire
Business Segments: Manufacturing & Services

Segments



Defense/Space





Business Conduct

- Competitive advantage & market diversification
- Invest in R&D, equipment, & production technology
- Advance strategic alliances and joint ventures
- Global FMS and MRO markets (Includes offsets)

Internal Business Drivers & CEO Priorities

- Expand commercial point to point market
- Production efficiencies; win new major systems contracts
- Leverage Innovation & Evolve DoD/Industry Partnerships
- Speed up product to market, ramp up deliveries
- Control supply chain costs (2-3% cheaper annually)
- Expand MRO across commercial and defense sectors

Government Relations/Influence

- Uncertain defense budgets & program appropriations
- Cost reduction initiatives & procurement regulations
- Performance and reliability requirements at lower costs
- Export/Import policies with customers & suppliers

BACKGROUND

Boeing is engaged in the design, development, manufacturing, sale and support of commercial jetliners, military aircraft, satellites, weapons, electronic and defense systems, launch systems, and advanced information and communication systems. The firm also provides performance-based logistics (PBL) and training and related support services principally to the commercial airline industry worldwide.^{336, 337, 338} The firm, as with all other firms in the A&D sector, is the product of a long history of mergers and acquisitions. Boeing as it exists today incorporates helicopter manufacturing firm Vertol Corporation of Philadelphia, purchased in 1960, Rockwell Aerospace and Defense, merged in 1996, and, most importantly, former rival McDonnell Douglas Corporation, merged in a \$13.3 billion deal in 1997. It is through McDonnell Douglas that Boeing is a participant in the fighter market, producing F-15 Eagles and F-18 Super Hornets.

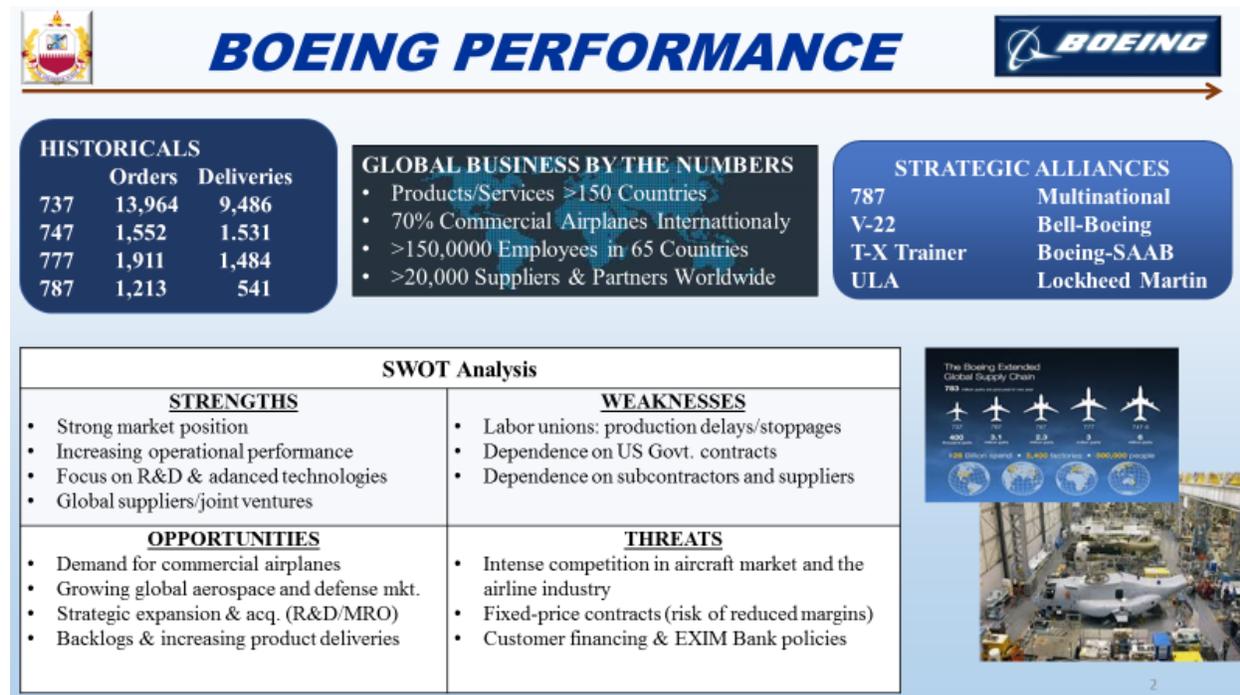
STRUCTURE

Boeing operates through five business segments: commercial airplanes; Boeing military aircraft; network and space systems; global services and support; and Boeing Capital. Boeing's business segments are explained as follows:³³⁹

(USD Millions)	2016 Segments	2012	2013	2014	2015	2016
Commercial Airplanes	69 percent	49,127	52,981	59,990	66,048	65,069
Defense, Space and Security	31 percent	32,607	33,197	30,881	30,388	29,498

Boeing Commercial Airplanes (BCA) makes up 69 percent of the Boeing revenues. The BCA segment develops, produces and markets commercial jet aircraft and related support services, principally to the commercial airline industry worldwide. Boeing Defense, Space and Security (BDS) makes up 31 percent of Boeing revenue and comprises of Boeing military aircraft, network and space systems, global services and support segments. Within BDS, Boeing Military Aircraft (BMS) represent 42 percent of the segment,

Network and Space Systems (NSS), including United Launch Systems (a joint partnership with Lockheed Martin), represents 24 percent, and Global Services and Support (GS&S), which sustains aircraft and systems with a full spectrum of products and services through integrated logistics, represents 34 percent.



CONDUCT

Boeing is trying to capture market share of the commercial airline industry with a long-term strategy out to 2035 through market reorientation. Boeing's main competitor is Airbus in the large capacity 100-seat or greater passenger market. Boeing and Airbus pursue the same \$5.9 trillion future market of 39,600 commercial aircraft potential sales over the next 20 years.³⁴⁰ Looking ahead, Boeing aims to be number one in commercial airplanes with differentiated products and demand-driven rates; lead in the key defense, space and security growth markets the firm is targeting; and be top in services, growing business significantly with a focus on lifecycle opportunities across multiple areas.³⁴¹ The firm's current strategy includes the following measures:

- Ramping up commercial airplane production profitable
- Strengthening defense, space, and security segments
- Launching an integrated services business sector
- Delivering on development programs
- Driving productivity and performance
- Developing teams and attracting talent

Specific objectives include:

- BCA: Look to China and India markets
- BDS: KC-46 and P-8 production efficiencies. Win T-X competition.
- Meet cost and schedule requirements on major defense programs³⁴²
- Expand maintenance, repair, and overhaul services domestically and internationally
- Partner with DoD on major weapons systems life cycle logistics and sustainment
- Create new business models

- Revitalize product lines using new technologies such as composite materials
- Partner with engine manufacturers on fuel efficient engines required by airlines
- Speed up product to market (ramp up commercial deliveries to deal with massive backlog)
- Control/reduce supply chain costs (two-three percent cheaper annually is Boeing's target with same or better performance)
- Increase C4: collaborate, capability, capacity, and cash
- Focus on quality, Best Value, and Flexibility

Boeing's management strategy continues to be to reshape the firm into a higher-profit margin, more diversified, increasingly nimble firm. In commercial aircraft, Boeing has a new confidence with the success of the next-generation Boeing 737 and 787 airliners and plans to launch the 777X using new technologies proven with the 787. Boeing is working to capture future point-to-point mid-range markets, especially in China and India, and may close out or reduce 747 production. Boeing is now in manufacturing development for 777X composite wings, allowing reduced weight and higher fuel efficiency.

In space, the firm is seeking to build up its commercial space work with key satellite wins that help offset a difficult environment in military space sales. Major programs for strategic defense and intelligence systems include: Ground-based Midcourse Defense (GMD); satellite systems: commercial, civil and military satellites; and space exploration: Space Launch System (SLS), Commercial Crew and International Space Station (ISS). This segment also includes Boeing joint venture operations related to United Launch Alliance.³⁴³

Boeing is working to leverage advanced manufacturing, technologies, and personnel across the commercial & defense businesses. The goal is to provide greater technological capability at lower cost. In military aircraft, Boeing claims the approach also will show savings in the operating costs of aircraft such as the P-8 and the KC-46 tanker by applying experience with the 737 airliners. Through U.S. military orders and exports Boeing is trying to extend its F-15 fighter, F/A-18 fighter and C-17 transport lines if possible. Boeing is looking at a \$2.2 trillion market over the next 10 years in defense programs driving investments into commercial derivatives, rotorcraft, satellites, services, human space exploration and autonomous systems. These investments are seen to help Boeing compete for future programs such as the T-X trainer, JSTARS recapitalization and numerous advanced weapons and unmanned systems. Boeing also determines continued access to global markets remains vital to the ability to fully realize sales potential and long-term investment returns.³⁴⁴

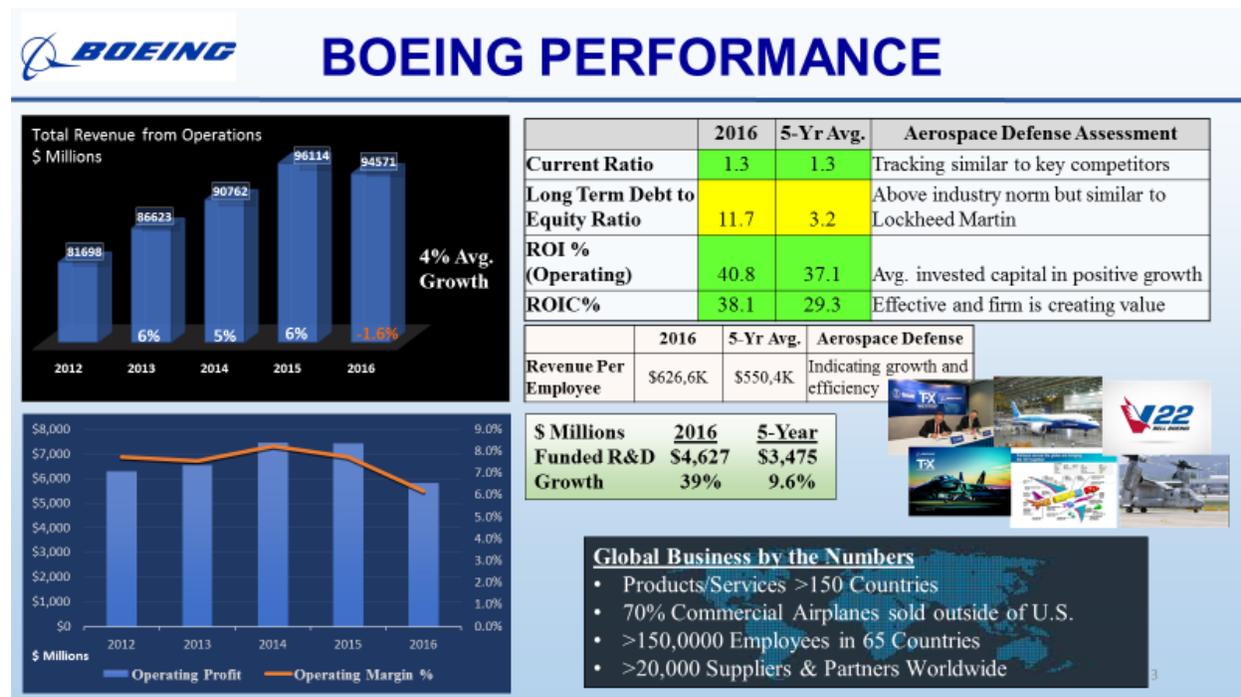
Boeing is dependent on the ability of a large number of U.S. and non-U.S. suppliers and subcontractors to meet performance specifications, quality standards and delivery schedules at Boeing's anticipated costs. While Boeing maintains an extensive qualification and performance surveillance system to control risk associated with such reliance on third parties, failure of subcontractors to meet commitments could adversely affect production schedules and program/contract profitability, thereby jeopardizing Boeing's ability to fulfill commitments to customers. Boeing is also dependent on the availability of energy sources, such as electricity, at affordable prices.³⁴⁵

Crystallized in their latest aircraft programs A350 and B787, both Boeing and Airbus have been adopting new strategies of product development and production organization since the late 1990s. Having redefined their supplier organizations and introduced new mechanisms of procurement and coordination, their common aim has been to cut development costs, to focus on final integration of aircraft systems and to reduce production lead times. Today, both companies claim that they have adopted a systems integration perspective in which, together with their design and development, manufacturing of major aircraft sections and systems is mainly performed by suppliers. The two companies claim to focus on their 'core competencies' primarily restricted to final assembly and supply chain management. Accordingly, they have been pursuing several cost-cutting programs in order to keep product development and manufacturing costs under control and to boost earnings, with important employment and financial implications. Broadly speaking, major differences between the two firms is in the patterns of their

knowledge and production bases. Compared to Airbus's much more active strategy to enlarge and contract its boundaries through higher numbers of acquisitions and divestments as well as investments out of its home countries, Boeing's investment strategy is largely restricted to the United States, while its outsourcing is characterized by greater geographical distribution as compared with Airbus'.

PERFORMANCE

In the case of Boeing, while the firm aims to reduce spending through outsourcing and increasingly conflicting labor practices, it has also extended its shareholder value orientation through dividends and stock buybacks and enlarged and diversified compensation mechanisms provided to executives and other high-ranking employees as means of value extraction. Financialization has deep roots in the firm. Compared to Boeing, Airbus has followed a balanced strategy, mitigating conflicting interests up until the present day. Despite the facts that it outsourced 50 percent of its latest aircraft program A350 and divested several business units as part of cost-cutting programs, the tension with the workforce and distribution of corporate cash to shareholders has so far remained under control. However, its most recent discourse and practices provides strong evidence that a more financialized business strategy is on the way together with ever-rising concerns of the workforce over job security.



According to estimates through 2016, Boeing's commercial and military aircraft revenue was expected to grow or stabilize at an annualized rate of nine percent to an estimated \$77.4 billion. In 2016 Boeing achieved \$94 billion exceeding expectations. Strong demand for commercial aircraft has been the primary reason for such strong performance, with the commercial aircraft division's revenue growing at an annualized rate of 16.1 percent over the five-year period. On the other hand, declining defense spending and the wind down of programs such as the C-17 has caused the military aircraft segment's revenue to decline at an annualized 1.2 percent rate of over the same period. Moreover, despite strong revenue growth, Boeing's operating profit declined in 2015 as the 787-program struggled to make a profit and KC-46 program costs Boeing adjusted upwards. In 2016, Boeing's revenue is expected to decline 2.7 percent as commercial aircraft production temporarily declines and defense sales fall.

With \$94.6 billion in overall annual revenue and more than 150,000 employees in 2016, Boeing is one of the world's largest aerospace companies. Revenue was split between product sales (89 89

percent) and services (10.71 percent). At the end of 2015, the commercial airplanes segment had an order backlog of \$431.4 billion, representing a 47.1 percent increase from 2011 levels. In the five years to 2016, Boeing's commercial and military aircraft revenue was expected to grow at an annualized rate of nine percent to an estimated \$77.4 billion. Strong demand for commercial aircraft has been the primary reason for such strong performance, with the commercial aircraft division's revenue growing at an annualized rate of 16.1 percent over the five-year period.

BCA generated \$65 billion of revenue in 2016 and led the industry in deliveries for the fifth consecutive year with 748 airplanes. Booking 668 net new airplane orders worth \$49 billion sustained a robust backlog of more than 5,700 airplanes valued at \$416 billion—more than seven years of production at current rates. Full-year operating margins were 4.8 percent.

BDS performance in 2016 scored healthy revenue and margins, winning important new orders, and achieving significant program milestones. Revenues were \$29.5 billion, driven by strong deliveries and services growth. Operating margins were 10.2 percent. In total, we delivered seven satellites, 178 military aircraft and 23,052 weapons systems (a 46 percent increase over 2015). Boeing also booked \$26.2 billion in new orders, maintaining a healthy backlog of \$57 billion, 37 percent of which is from international customers.

Overall, both the current and six-year average indicates Boeing is thriving over the medium and long term, showing an average invested capital is still in a positive growth status, creating value for the firm. ROIC with its weighted average cost of capital (WACC) reveals invested capital is being used effectively. Based on and ROIC of 38.13 percent greater than a WACC of 13.07 percent then ROIC is indicating the firm is creating value. Boeing is a prime example of a firm that has managed to remain well diversified across both defense and commercial markets.

associated with that relationship and the pressure to win large, winner-take-all contracts like the next generation bomber it successfully pursued. Threats of cancellations and fewer programs drove the firm to seek diversification to reduce the risk associated with depending on Washington for over 84 percent of revenue.

CONDUCT

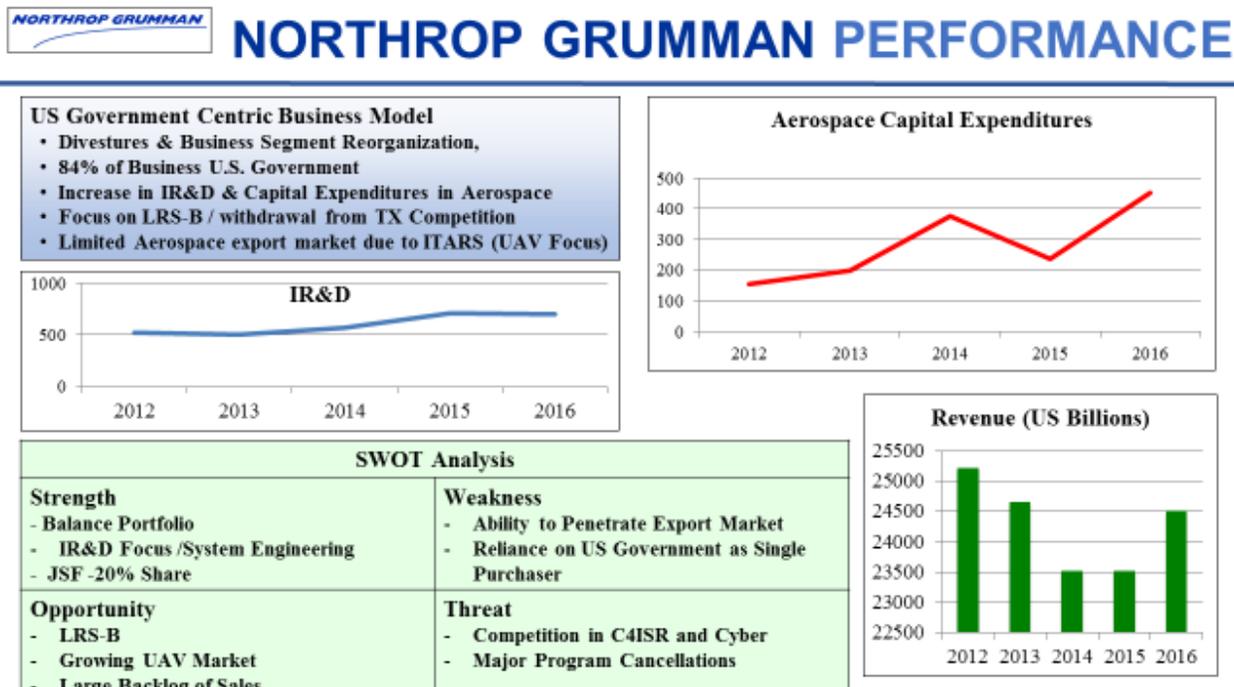
Northrop Grumman's strategy at the corporate level focuses on long-term value creation and alignment of corporate governance to support long-term profitable growth. Between 2010 and 2013, the corporate strategy entailed share buybacks to return profits to shareholders. The trend of fewer acquisitions and key divestures signaled a movement into maximizing the return on the capital investments represented by previous acquisitions in order to build long-term value and reduce risk. The reality of the situation drove the market structure of Northrop Grumman into two key strategies. On the one hand, the strategy focused on creating growth through the movement into new markets and by increasing market share in existing markets. This drove an expansion into key markets including the UK and Australia, strengthening the firm's international presence and market share. On the other hand, the strategy also triggered a restructuring of business sectors and an increase in joint ventures and partnerships. These two factors will continue to drive a cyclic approach to Northrop Grumman's acquisitions, mergers, R&D and capital investments that will follow along the large U.S. programs that are so vital to the firm's viability. As demand signal grow, Northrop Grumman will focus on those core capabilities to support that demand by increasing R&D and capital investments. Before the bomber win and during the shift to external global business models, the government provided little incentive. When production lifecycles end, focus moves towards sustainment and support of programs. Decreasing production results in the firm decreasing risk through capital investments and maximizing the current business model until the demand signal strengthens. Northrop Grumman moved along this path from 2010-2013 and with the winning of the new bomber.

Since 2013 and the winning of the new bomber contract, however, Northrop Grumman shifted focus to R&D investments in order to maintain competitive advantages within its core portfolios. Acquisitions made by Northrop Grumman supported strengthening the core competencies especially in C4ISR, cyber and autonomous systems to include UAV's. R&D increased from \$520 million to \$705 million. Identification of the need to increase R&D drove Northrop Grumman to reduce the number of its business segments in order to increase return on investment. "In 2016, as in prior years, we engaged with our shareholders on a variety of corporate governance matters, including our strategy for long-term value creation and further aligning our compensation and governance practices to support long-term profitable growth and value creation."³⁴⁸

With long-term value creation, stakeholder responsibility and return on investment to shareholders dominating the corporate strategy, structural changes in the business segments drove a focused effort into five key system products of the three business segments. The strategy focused on the investment of capital to support critical core capabilities centered on the acquisition of companies with strong core capabilities in support of C4ISR and cyber that would strengthen Northrop Grumman and increase its competitive advantage within those areas. All core capabilities feed a balanced and diversified portfolio that spreads risk within each portfolio, enabling the spin-off of units when they no longer provide the prospect of long-term value.

This strategy of purchases and divestures dominates Northrop Grumman's strategy and enables the firm to continue to focus on returns to investors and retaining a competitive advantage through investments in the primary core competencies. One specific problem with the strategy and the focus on high-tech systems, however, is that most of the items the firm produces have limited export prospects due to export controls. This is one reason that Northrop Grumman remains so dependent on the U.S. market and government spending cycles. While Northrop nonetheless seeks to create value in the export market by investing in systems like the Fire Hawk that might be sold in both the U.S. and foreign markets, its ambitions are often stymied. The problem with this strategy is that as long as the U.S. government is an

intended customer, its the frequent changes of requirements for systems like the Fire Hawk decrease the viability for sale in the export market by increasing the cost associated with the capabilities.



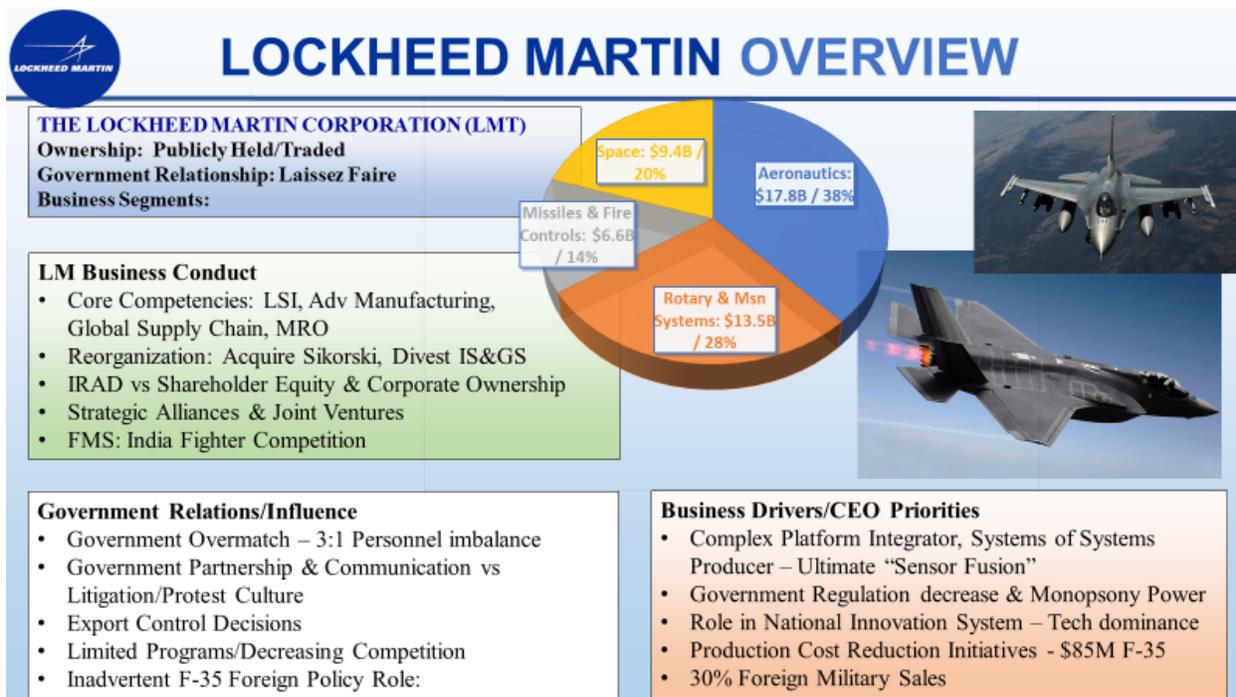
PERFORMANCE

Northrop Grumman's financial reports over the last five years portray a firm focused on returning capital to investors rather than risking investments in capital absent a strong demand signal from the government. The acquisitions from the previous 15 years established the core competencies for the firm to build long-term value. The focus of this period was on strengthening the core competencies with key strategic wins. With the increased demand signal of the long-term bomber program, the investment into R&D also increased. This period reflects the long-term return on capital investment achieving success for the firm. Northrop Grumman's revenues fell during the period depicted in the figure above due to many factors. Although revenues do not fully reflect the true health and long-term value of a firm, they do represent the decrease in demand for military products and services along with the divesture of the shipbuilding portfolio. 2016 and projected 2017 revenues start an upward trend primarily due to the firm's 18 percent share in F-35 development and production. Based on the projected market share of the F-35, revenues should continue to increase as long as Northrop Grumman maintains a focus on winning key contracts within the core capabilities of the portfolios they spent the last 20 years building.

The level of cash flows determines the amount of liquid assets the firm can leverage to invest in capital or return to investors. Cash flow generally follows the increase and decrease within Northrop Grumman's revenue trends. With the increase in revenues and focus on lean programs throughout the key portfolios, the firm is postured to maintain reasonable levels of cash in order to invest without increasing long-term debt. The decrease in cash flow in 2015 represents the significant increase in R&D capital investments and share buy-backs during that year. Long-term debt continues to increase during this period primarily due to the loss of a few programs and the investment in R&D in order to remain competitive. With the structural adjustments, the firm slowed the annual increase to less than one percent from the previous year's increase of four percent. The long-term debt will continue to slow the pace of growth for Northrop Grumman, although the return on invested capital of 20 percent creates less of a problem in terms of the level of debt.

The return on invested capital shows a significant climb as the firm focused efforts within the core capabilities over many years. “The sector is taking on more debt to finance stock buybacks, acquisitions, and product development, especially in the United States, taking advantage of historically low interest rates.”³⁴⁹ The series of investments is starting to pay off and will eventually offset the current debt levels, especially with the F-35, Global Hawk continued funding, and finally the large win of the new bomber. However, Northrop Grumman is below the global A&D sector’s average return on invested capital (ROIC) of 24.5 percent. Ranked tenth overall out of the top 20 A&D companies, the firm’s current ROIC falls below an eighth place ranking of total revenues.³⁵⁰ Increasing this growth rate within the current portfolios looks promising based on the current focus on R&D and specific segments of the market.

LOCKHEED MARTIN



BACKGROUND

The Lockheed Martin Company (LM) corporation in its various past formulations has been a crucial component of the U.S. DIB for the last hundred years, and is positioned to continue designing and producing defense capabilities well into the future. LM has survived the post-Cold War aviation consolidations to emerge as the largest defense firm in the world by sales.³⁵¹ Despite significant competition and dynamic world geopolitical and budget environments, LM’s short- to medium-term sales outlook and product line is strong. Through an aggressive portfolio realignment and strong military aircraft market share, specifically fighter and rotary wing, LM’s corporate strategy is poised to keep them at the top of the defense industry for many years. Despite a broad portfolio, LM has largely limited itself to defense, with only two percent of 2016 sales coming from the commercial market.³⁵²

STRUCTURE

Since the 1995 merger with Martin Marietta, LM has acquired 42 companies, as it searches to find the right balance of product lines and external environment alignment.³⁵³ These firms provided LM with a broad spectrum of high-tech intellectual property (IP) like IT capabilities, network communication, global supply chain systems, and wheeled vehicles.³⁵⁴ Other primes in the industry followed similar strategies, as major defense contractors pursued DoD’s drive for network centric warfare and systems-of-systems platforms. Today, LM is organized into four operational segments with corresponding percent of total sales in 2016: Aeronautics (38 percent); Rotary and Mission Systems ([RMS] 28 percent); Space Systems (20 percent); and Missiles and Fire Control ([MFC] 14 percent).³⁵⁵ The following table displays the business segments and their 2016 sales and percent of corporate revenue.

Segment	Profit (\$B)	Percent of Total Sales
Aeronautics	17.8	38%
Rotary & Mission Systems	13.5	28%
Missiles & Fire Controls	6.6	14%
Space	9.4	20%

Business Segments and Profit³⁵⁶

In 2015, CEO Marillyn Hewson, made the first of two sweeping realignments. LM acquired Sikorsky from United Technologies Corporation for \$7.1 billion, taking a major stake in the rotorcraft industry for the first time. This acquisition attained several goals in LM's corporate strategy. First, it reduced the dependence on the F-35 for sales. Second, it increased overseas market exposure due to the fact that Sikorsky generated nearly 50 percent of its sales to foreign customers. Third, it accelerates LM's MRO objectives through services the thousands of UH-60 and other Sikorsky helicopters over the next several decades.³⁵⁷ In 2016 LM executed its second major organizational change by divesting itself of an entire business segment, IS&GS, which had generated \$5.6 billion in 2015 sales. LM determined that the smaller IT and technical services contracts that made up the IS&GS portfolio were no longer adding enough value to the corporation and that it needed to refocus on its core competencies as defined above.³⁵⁸ This internal realignment is the result of LM's industry analysis and subsequent reposition and has completed the publicly acknowledged major portfolio changes.

CONDUCT

As Porter suggests, good strategy is the result of good analysis and leads to a sustainable competitive advantage.³⁵⁹ A firm must accurately assess its external alignment (position in the industry) then maximize its internal alignment (organization and processes) to craft a long term corporate strategy. LM has accomplished this by concentrating on its core competency. LM has become one of the preeminent defense corporations by orchestrating complex, high-tech programs as a lead system integrator (LSI). Its engineering force is effective at designing high-end, technologically advanced products that satisfy the U.S. government's requirements for military advantage over its adversaries. LM also incorporates cutting-edge manufacturing techniques to produce exacting products efficiently. The goal of these production facilities is to produce high-volume production like the F-16 (over 4,500), the C-130 (2,500), and F-35 (over 2,400 anticipated).^{360,361} LM, however, has also often produced low-volume exquisite systems (SR-71, F-117, RQ-170). Additionally, as an original equipment manufacturer (OEM), LM has become extremely proficient at managing a global supply chain and overseeing final integration.

This is illustrated in the F-35, where components are manufactured around the world by its partner nations and shipped to Fort Worth or Italy for final assembly. Finally, as many OEMs have discovered, margins on MRO are often higher than those from building and producing the original aircraft.³⁶² LM has the significant advantage of holding the technical data to all of its designs and therefore, a critical IP advantage in the MRO markets of their products. The core competency combination of extremely high-end engineering, manufacturing, and global supply chain management makes LM one of a very few companies that can create these complex defense systems of systems. Adding the ability to maintain and modernize these abundant platforms effectively gives LM a distinct comparative advantage. Furthermore, each of these core competencies can be used across diverse product lines, which can provide some revenue stability through diversification.

LM has entered into several key JVs and alliances. Perhaps the most important partnership to firm strategy and profit is the conglomeration of partners on the F-35 program. Currently there are ten foreign partner countries spread across four different tiers (including straight FMS). Furthermore, Northrop Grumman and BAE have considerable stakes in the design of the F-35. Finally, there are hundreds of subcontractors that support manufacturing.³⁶³ Work shares are an important aspect to this program and often cause a significant amount of political maneuvering by LM senior leaders to help keep all partners

satisfied with the level of manufacturing or MRO that is occurring in their countries. Apart from the F-35 LM's Sikorsky subsidiary and Boeing are collaborating to create the SB-1 Defiant, which will compete for the Army's upcoming Future Vertical Lift (FVL) competition. Finally, a JV that has been instrumental to LM's Space segment is the United Launch Alliance, which again partnered LM and Boeing. Created in 2006, this JV held a monopoly on space launch until SpaceX was recently awarded a USAF contract.³⁶⁴

Sometimes the most important part of strategy is determining what not to do. For example, over the last several years, LM's aeronautics engineers have been feverishly working on completing the development and fielding of the F-35. The engineering effort dedicated to this program has possibly tapped all available aerospace, software, and system integration engineering manpower. Therefore, when the TX competition presented itself, LM may have found additional value in an already proven aircraft (T-50) because a clean sheet design would have overextended its engineering workforce. Unfortunately, the nature of sparse large defense programs creates cycles of manpower needs. As F-35 advances and the TX requires less engineering support, LM will have need to find new projects for its human capital.

Over the last three years LM has spent \$988 million in 2016, \$817 million in 2015, and \$733 million in 2014 on R&D. This represents approximately two percent of sales in 2016. This is well below European competitors like Airbus (5.6 percent), Dassault (9.7 percent), and Saab (6.5 percent).³⁶⁵ It is also less than domestic competitors Boeing (3.2 percent) and Northrop Grumman (2.9 percent).^{366,367} The broad consensus has been that DoD had not transmitted a requirement, in the form of an upcoming program of recorded, in a concrete enough manner to increase the size of R&D expenditure.³⁶⁸ Perhaps the upcoming Future Vertical Lift program will incentivize this type of investment. It is important to note that LM R&D investments have nevertheless been increasing over the last several years. Therefore, some slow shift in policy or future opportunity is presenting itself. LM's public strategies note five emerging technologies they are putting efforts in: advanced aeronautics, nanotechnology, robotics, advanced manufacturing, and quantum computing, while CEO Marillyn Hewson added directed energy, autonomy, hypersonic, and advanced materials to this list during her remarks at the firm's 2017 media day.

FMS have always been an important part of the LM strategy. As a core aspect of LM corporate strategy, FMS serves as a way to smooth the cyclical nature of U.S. government acquisitions. In 2016, 27 percent of total sales came from foreign customers and LM's CEO has a goal to raise this to 30 percent over the next few years.³⁶⁹ Several of the aeronautic and RMS segment's key products have been widely sold overseas, including the C-130, F-16, F-35, and UH-60.

Perhaps the best indicator of LM's future strategy is how many of the seemingly disparate products in its realigned portfolio interconnect. For example, in 2016 an F-35B detected an over-the-horizon target, transmitted the data to an interoperable Aegis weapons system, which then engaged the target via surface launched missile.³⁷⁰ This type of activity begins to extrapolate a long-held crown jewel of LM's IP, "Sensor Fusion." Hewson may have alluded to her LM vision when she said, "We want each "smart node" on the modern battlefield to be seamlessly connected, integrating air, space, land, and the cyber realm."³⁷¹ Taking together LM products like Theater Battle Management Core System, communications and sensor satellites, air- and ground-launched missiles, UAVs, fighter aircraft, and cyber capabilities, a true idea of global situational awareness which can be exploited at the tactical level emerges. Add the philosophy of open architecture and customizable applications, and a long term competitive advantage is evident. Imagine if an F-35 could be fed over the horizon information from satellite constellations or orbiting stealthy UAVs, providing the kind of global SA that fighter pilots have dreamed of for decades. Add to this any number of weapons that are currently in R&D at LM. This would be an example of the realization of the Third Offset Strategy. An integrated system of systems that could counter the anti-access/area-denial challenge. Hewson alluded to as much in her remarks such as, "The interoperability of the F-35 also provides a critical insight into our approach to innovation and value creation... We seek to enhance and integrate our platforms ... [and] We will bring a more holistic operational picture of the battlespace."³⁷²



LOCKHEED MARTIN OVERVIEW

REVENUES (millions)	2016	%
• Aeronautics	\$17,769	37.6%
• RMS	\$13,462	28.5%
• Space	\$ 9,409	19.9%
• MFC	\$ 6,608	14.0%
Total Revenue	\$47,248	100%

SWOT Analysis

STRENGTHS

- External/Internal Alignment of Core Competencies
- Diverse Cash Generating Portfolio
- Strong Strategic Alliances, JVs, and IRAD investment areas

WEAKNESSES

- Monopsony Govt Relationship: Spending & ITAR decisions
- High debt to equity ratio – 9.45

OPPORTUNITIES

- Global defense spending growth – capitalize on strong fighter & rotary wing market share
- Growing MRO market
- “Sensor Fusion” System of System approach

THREATS

- Shrinking competitive environment
- New external competition



	2016	2015	2014	2013	2012
R&D % of Revenue	2.09	1.82	1.65	1.54	1.31
R&D (Billions)	0.988	0.839	0.751	0.697	0.616

PERFORMANCE

An interesting dichotomy is that LM’s long-term value and short-term shareholder value may not fully align. Like many in the aerospace industry, LM worked hard to satisfy shareholders. In 2016 LM paid out \$2 billion in dividends, which “marked the 14th consecutive year that the dividend rate has been increased by a double-digit percentage.”³⁷³ Moreover, LM repurchased 8.9 million shares (\$2.1 billion). These actions point to a corporate calculus that it was advantageous to spend funds on near-term shareholder value, rather than invest in long-term value through capital investments or debt reduction. Shareholders were the big winners; LM’s stock price increased almost 200 percent over the last five years. Part of this approach may be explained by LM’s ownership structure. The top five shareholders and at least 37 percent of stock are owned by investment management groups.³⁷⁴ It is significant that these shareholders are investor focused, primarily working towards generating short-term profit.

Over the last three years revenue and operating profit have steadily increased. These numbers are expected to continue in an upward direction based on F-35 sales (Aeronautics segment) and growth in the Sikorski subsidiary (RMS segment). However, F-35 profit margins (especially in the development phase) were meager.³⁷⁵ Slow growth predictions were also made in several stock market analysis groups over the next few years.³⁷⁶ ROI validates the fact that the A&D industry is highly capital dependent. Historic weighted cost of capital is around eight-nine percent.³⁷⁷ While ROI is greater than this, proving that LM is able to create value above the cost of capital, the margins are small, demonstrating that the defense industry is highly competitive and government policies are efficient at keeping profit margins low. LM’s operating margin was 11.74 percent in 2016, while the U.S. A&D top-20 companies earned an average of 11.4 percent and the global top-20 A&D earned 9.8 percent.³⁷⁸

Finally, LM’s long-term debt to equity ratio of 945 percent is concerning. In 2015, long-term debt increased from \$6.17 billion to \$14.31 billion. Most of this increase came from the \$7.1 billion Sikorski deal. Whether the Sikorski bet pays off in the long run is still too to be determined. However, the recent Sea Stallion contract and the promise of the huge Future Vertical Lift competition provide optimistic projections. LM’s fourth quarter 2016 financial results conference call displayed optimism concerning 2017. Revenues and profits were projected to increase in all segments, except space, with strong cash generation. Most importantly, the portfolio shaping and restructure activities have been completed and LM considers themselves, “Positioned for long term value creation.”³⁷⁹

VII. DIAGNOSTICS OF GOVERNMENT ACTIONS ON FIRM BEHAVIOR

For purposes of this paper, government policies are driven by three principal externalities with regard to the A&D market. These are: (1) the security environment; (2) global technological competition; and (3) commercial market trends. These externalities have an effect on both the domestic and international markets with which corporations interact. The following section will look at the policy levers that governments pull in reaction to (or as an attempt to shape) these dynamic externalities. These policies and decisions have significant effects on firm behavior as they strive to achieve corporate objectives as well as create and create competitive advantages in their specific markets. Ultimately, a country's DIB is primarily made up of these defense firms, and the competitiveness of these DIBs reflects the abilities of the firms. Each country's policy choices and firm reaction will be analyzed one by one, with an additional analysis of DIB competitiveness.

This section attempts to make general observations regarding trends in DIBs for the nations assessed in this paper. To maintain a competitive advantage, a country's portfolio of military capabilities should align with expected and executed military contingencies. To maintain a portfolio of capabilities, the DIB should be able to generate weapons that meet the demands of a state's national security strategy (NSS). Additionally, given that national resources that are consumed to develop a portfolio of capabilities, a competitive DIB should create capabilities by efficiently delivering value to taxpayers. This efficiency comes through competition and collaboration that provides capability at bearable costs. Bearable costs must also be at a level that ensures ongoing firm profitability and financial stability. Financial stability is not just a function of firm performance, but also ensures that there is a proper mix of firms in the DIB. Finally, a DIB's competitive advantage should also help maintain and be sustained by a culture of innovation.

UNITED STATES



United States Policy Lever Effects



The United States' global lead in defense technology is being actively eroded by potential competitors who themselves are pursuing advanced technologies to develop asymmetric capabilities that challenge the United States' ability to carry out critical missions.³⁸⁰ Potential adversaries such as China,

Russia, North Korea, and Iran are embarking on military modernization programs to enhance their military strength. Drivers that assist them in closing the gap are globalization and the innovation environment, acceleration of dominant commercialized technologies, as well as exploitation or copying through a wide variety of technology transfer mediums.

Defending the international system against Russian attempts to undermine it is again a requirement based on Russia's renewed aggression and opportunism aimed at exploiting weaknesses and gaps in Western allied security strategies. Russia's strategy appears positioned toward engaging in grey-zone levels of aggression that fall short of traditional acts of war so as to gain an advantage but not provoke forceful military responses by Western allies. The term "grey zone" in this context refers to operations, specifically those that are more difficult to define as either peace or war, and indeed possibly those undertaken intentionally to obfuscate and blur the lines between the two. Aggression toward the Republic of Georgia, occupation of Crimea, eastern Ukraine, and military operations in Syria are examples. However, regional tensions are rising based on Russia's grey-zone posturing such as in the Baltic Sea region, where Sweden has taken actions to close possible gaps in its NSS and military capabilities.

As stated previously, with U.S. defense budgets decreasing and major acquisitions programs shrinking or being cut outright, pursuing additional foreign sales of U.S. military equipment has become an increasingly important strategy for U.S. defense companies, and for U.S. government organizations concerned with sustaining the domestic DIB. Markets in countries such as India, Iraq, and Brazil could provide opportunities for the United States, which might be able to leverage FMS to attract new partners and relationships from among states that during the Cold War were unlikely allies. At the same time, FMS is a mechanism that helps underpin longstanding relationships with states in Europe and Asia (Japan, Korea, Thailand).

Strong growth from major commercial aircraft sales (excluding Boeing, helicopters) grew significantly over the last year. This strong growth has impacted the rest of the industry (engine, component, first and second tier suppliers etc.), resulting in robust growth for the entire A&D industry. Loss of military spending has made the OEMs focus more on the commercial aerospace segment. With Boeing and Airbus reporting significant backlogs over next decade, A&D industry demand across manufacturing segments (aircraft, engine and Tier 1 components) is expected to exceed \$5.6 trillion over next 20 years. Due to the increased cost-reduction focus (across the supply chain) by aircraft OEMs, engine OEMs and tier-one suppliers are hard pressed to look for other profitable sources of revenue and profitability.³⁸¹

U.S. government policies choices set the overall framework for the market. The Budget Control Act still remains in effect causing budget uncertainty and risk of future sequestration. Budget cuts or investment priority changes could result in reductions in major programs and could have a material effect on the results of the firm's operations, financial position and/or cash flows.³⁸² At the same time that budgets are under pressure, U.S. network-centric warfare requirements continue to push defense primes towards products of greater complexity. This in turn drives costs up, allowing for only a small number of new programs which stretch the defense dollars. The decrease in the number of programs creates a "franchise program" or "once in a generation" weapon systems, where primes must compete ferociously for these winner-take-all procurements.

These increasingly rare programs also seek high degrees of innovation in the quest for a "third offset." Near-peer competitors have challenged the status quo of U.S. technological superiority as they seek a variety of asymmetric capabilities to counter the United States' overwhelming conventional military advantage. Advances in anti-access and area denial (A2AD) capabilities have begun to threaten the United States' previously unfettered ability to project military power overseas, which has been a central element of U.S. military planning.³⁸³ The United States must pursue advances in third offset technology in advance of its potential adversaries in order to maintain its power projection superiority. DoD-driven technological innovation has delivered unmatched national security capabilities for the United States for the greater part of seven decades, underpinning a sustained period of security in an uncertain global environment. While the United States still holds the leading position in military

technology innovation, the gap with the rest of the world is shrinking. Harnessing cutting-edge technology in a world where innovation is increasingly occurring beyond the traditional jurisdiction of government-funded DoD R&D programs remain a necessary component to maintaining military technological dominance. However, this model is no longer sufficient for future DoD needs or technology superiority. The DoD must continue to look beyond traditional industrial and geographic boundaries and proactively leverage outside innovation. It is encouraging better awareness of outside innovation; and is working to further enable better access to that outside innovation once it has been identified.³⁸⁴ The U.S. government has begun to use specific acquisition programs as the foundation of alliance and political partner building. The F-35 currently interlinks 11 countries together through an interoperable combat asset, which also entails technology sharing, manufacturing workshare, and economic interdependencies.

Declining defense budgets and a push towards high-tech solutions has caused defense primes to reorganize by shifting their portfolio makeup. For example, in the last two years Lockheed Martin has purchased Sikorski as well as divested its IS&GS division in order to capitalize on the shifting market created by government procurement decisions. At the same time, large programs have led to an increase risk in prototype competition due to the significant investment of corporate funds to accomplish (approximately one percent of the total program projected cost). To reduce this risk companies that can no longer consolidate have increasingly engaged in strategic partnerships or joint ventures. For example, the major players in the T-X competition have all attempted to partner with international companies to share costs and design engineering labor. As a result, however, supply chain management and critical oversight of globalized supply chains is a significant challenge. Oversight of the work being done by tier one partners and other tier subcontractors/suppliers is required by OEMs providing insight into what's actually going on in those [partner] factories. Adequate insight and collaboration aids suppliers understanding of prime OEM challenges.³⁸⁵

<u>DESIRED ATTRIBUTES OF THE AERO/DEFENSE DIB</u>	<u>United States</u>
Portfolio/Contingency Alignment with Industry Partners	
•Current Military Capability	Full Spectrum (A2/AD problem)
•Industrial capability to support the NSS	Defining 3rd Offset Strategy
Value	
•Deliver desired capability at lowest cost	Exquisite Costly Systems
•Competition, collaboration	Msn Set Monopolies
Industrial Surge Capacity	
• Required time for a substantive increase in production rates	Exquisite Manufacturing Supply Chain Challenges
Firm Financial Stability	
•Performance of industrial partners is supported by investor capital flows	Revenue/Profits Strong
•Is there a reasonable structure of firms in the DIB	3 Primes (Msn Set Monopolies)
•Beneficial externalities generated for the country	Largest Exporter
Innovation Toward Maintaining Competitive Advantage	
•National Innovation System available to defense industrial partners	Commercial tech faster than military
•Innovation in technology, manufacturing and concepts of operations	Conop innovation to leverage COTS
•Beneficial externalities generated for the country	Continued spin-off tech
International Influence	Strong Partner/Alliance Influence

In the case of the United States, regarding current capability, there are concerns regarding weapon systems lethality and survivability in an A2AD environment. While DoD is pursuing a third offset strategy to compete in these environments, it is not clear that this has been properly communicated to industry in a way that fully supports the NSS. Delivering value is also a challenge, with many exquisite systems growing in cost. These exquisite systems increase barriers to entry for other companies, limiting

competition in the market with near monopolies in some mission sets. Furthermore, exquisite systems typically also require exquisite manufacturing lines and highly complex supply chains that make it very difficult to increase production significantly in the case of high attrition rates during protracted conflicts. While U.S. firm performance is in general strong, the infrequency of programs creates uncertainty for firms and instability in revenues and needed workforce. Additionally, while there are efforts to bring different types of firms into the DIB through such efforts as Defense Innovation Unit Experimental (DIUx), *de facto* there are three large prime contractors. That noted, there continues to be positive externalities generated by U.S. DIB exports. While the United States continues to be one of the most innovative countries in the world, there are challenges in ensuring that commercial innovation is being sufficiently leveraged for weapons systems. Part of this results from a shortfall in innovation in concepts of operations that effectively employ commercial technologies. Nonetheless, defense technologies continue to provide spin-offs to commercial users. Finally, the U.S. DIB continues to provide the United States strong tools to influence the international security environment through exports, technology sharing, and military interoperability with allies.

UNITED KINGDOM



UK Policy Lever Effects



The United Kingdom supported NATO in Afghanistan and Iraq in expeditionary conflicts focused on counter-terrorism during the 2001-2015 timeframe. Based on resurgent Russian aggression in Europe, the UK needed to refocus its security policy toward territorial defense by creating a self-deployable global force projection capability, not limited to the context of NATO capabilities. The UK had numerous fighter manufacturers before, during, and after World War II, but those progressively merged and effectively reduced to BAE (for aircraft) and Rolls Royce (for engines). BAE is a key 13-15 percent supplier for F-35 for fuselage, empennage & electronic warfare. BAE also has a 20 percent share in Reaction Engines, which may yield a hypersonic engine for commercial and military applications. In 2014, BAE won the Boeing 777X competition for upgraded avionics.

The UK has increased the defense budget in 2016 for the first time in six years: "Over the next decade MOD will spend over £178 billion on equipment and equipment support, £12 billion more than in plans prior to the 2015 SDSR.³⁸⁶ The UK is committed to two percent GDP for defense. The UK NIS is distinct from a U.S. template, particularly in terms of how the UK tender system assumes that industry partners be prepared to develop systems ready for procurement. In that sense, programs do not include a significant development phase. Some of this is semantical, since programs may take several years to procure, consistent with a design phase before production.

One way the UK has preserved its DIB has been to globalize it. The UK has the most developed banking system in the world, open to FDI. The only historical impediments were the golden shares for UK defense companies. The "golden share" concept evolved to the "special share" construct, where the UK retains a veto authority for actions of the defense firm and that no single voting member can have more than a 15 percent share. Similarly, the UK maintains a strong export philosophy; somewhat hampered by the baggage of colonial history in places like India. It maintains a "special relationship" with the United States, collaborating broadly across DIBs.

BAE is the third largest defense firm globally and the largest one in the UK. As such it has maintained a strong position in the UK, United States, Saudi Arabia (as well as wider Middle East), and Australia. It also has holdings in Sweden, adding a positive coupling with the Nordic defense market. With larger defense budgets in the UK and the United States, it is likely that BAE will increase proportionally to budget increases. It is less likely that BAE will expand in the United States beyond this

proportion, due to greater competition in the U.S. market. BAE dropped out the South African market in 2014, selling its holdings in a South African land armaments firm. It also sold its holdings in Saab, based on a decision to focus on its domestic Typhoon Eurofighter offering, instead of the Saab Gripen.

MRO is a key market on which BAE focuses. It won the European F-35 MRO competition and also has a facility in Australia. It also has extensive MRO with Saudi Arabia and supports Oman.



Diagnosics – DIB Competition (United Kingdom)

DESIRED ATTRIBUTES OF THE AERO/DEFENSE DIB	UK
Portfolio/Contingency Alignment with Industry Partners	
•Level of capability (i.e. Nuclear, Third Offset, Major/Minor Systems, 6th Generation fighter)	Green: Nuclear Submarines, Cyber, most significant JSF partner
•Industrial capability to support the NSS (don't know their NSS?)	Yellow: 2nd only to US
Value	
•Deliver desired capability at lowest cost	Yellow: Difficulty in maintaining schedules
•Competition, collaboration	Yellow: Historical National Champions in BAE, Rolls Royce, Babcock
Industrial Surge Capacity	
•How long would it take to have a substantive increase in aircraft production rates	Yellow: International Supply Chain
Firm Financial Stability	
•Performance of industrial partners is supported by investor capital flows	Green: Capital Markets extremely Free; Golden Shares replaced by Special Share
•Is there a reasonable structure of firms in the DIB	Green: Yes, not much intracountry competition
•Beneficial externalities generated for the country	Green: Yes, Industry success tied to foreign policy
Innovation Toward Maintaining Competitive Advantage	
•National Innovation System available to defense industrial partners	Yellow: Companies and Govt tied, less to Academia
•Includes innovation in technology, manufacturing and concepts of operations	Green: Strongest in Air/Maritime/Cyber, less in Land
•Beneficial externalities generated for the country	Green: Vast Export Market; JSF MRO&U
International Influence	Green: Rolls Royce Engines best example

The UK maintains many aspects of a broad DIB, second only to the United States in the West. Many U.S technological advantages include the “special relationship” with the UK. The UK has nuclear missile submarines, plus is building two aircraft carriers. The UK has a few national champions that do not have competitors in certain markets. The UK historical relevance to engine technology continues with Rolls Royce plus BAE with the 20 percent holding in hypersonic developer Reaction Engines Ltd.

Nonetheless, with more modest budgets than the United States, coupled with smaller quantities and markets without domestic competitors, the UK is tolerant of schedule delays, creating additional costs. In one sense, this is the sovereignty price necessary to sustain a national DIB. The UK defense companies subject to the golden share have global supply chains, already at low rate, vulnerable to interdiction and difficulty to maintain low slack in inventory. The lessons that Toyota and other Japanese manufacturers learned with the Fukushima Daiichi nuclear disaster have not been applied to the UK supply chain.

A particular DIB strength is that the UK is home to one of the world’s most developed capital market, with benefits to the UK economy. This has also supported an innovation system that has strong ties between industry and government. The tie to academia is less evident, but there is a Defense Growth Partnership that is attempting to connect the sectors more coherently.

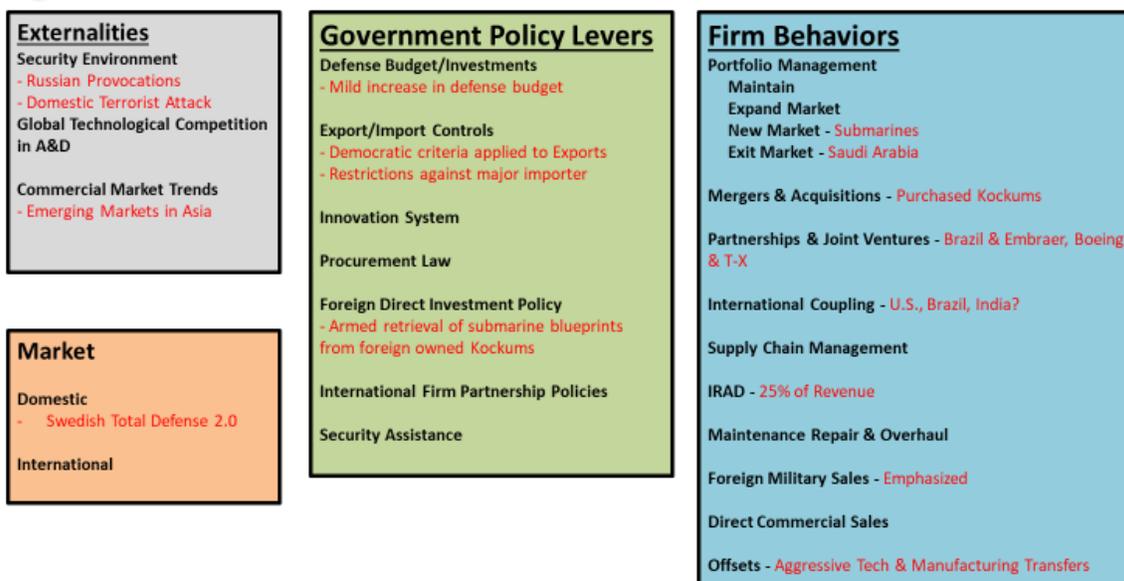
The UK defense market, albeit much smaller than that of the United States, still contests across air/land/maritime/cyber and MRO for both air and maritime. On the commercial aerospace sector, Rolls Royce is a major global player in a broad range of engines in the aerospace, land and maritime domains. Much of the UK’s global orientation stems from its history as an imperial power. However, as Britain’s historical ties with its many former colonies and protectorates atrophy, its commercial relationships are also changing. In the case of BAE, the firm has somewhat narrowed its vision to a significantly tighter scope, limited to the United States, Europe in specific countries that lack a national champion, Saudi

Arabia and Oman, plus other Gulf Cooperation Council members and Australia. It has some position in 18 countries based on sales of over 1,000 Hawk Trainer aircraft, but it has not translated into other products. BAE's F-35 participation does not change this dynamic. BAE's land armaments holdings in Sweden, however, helps to garner support in the Nordic Region, including Norway and Estonia. UK DIB firms seek collaboration with European partners, an excellent example of which is BAE's 37.5 percent MBDA joint venture in missiles, although further relationships may be hindered by Brexit. Counter to this, however, NATO's collective realization of the threat a newly aggressive Russia poses may outweigh Brexit's centrifugal influence, keeping the UK actively engaged in Europe, no matter the country's relationship with the EU.

SWEDEN



Sweden Policy Lever Effects



Unclassified

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A firm is ultimately successful only if it accesses markets with success. With reference to Saab's relationship with Sweden, the firm and government have shared close ties throughout their history. With the improvement to the security environment improved after the Cold War, globalization and technological advances caused competition to increase in the A&D sector. The combined effects of these external factors caused Sweden to opt for a peace dividend and reduce spending on defense. Saab and Sweden jointly realized that liberalization and a move away from autarky was the only way for the firm to survive in the new defense environment, as previously noted. This simple explanation, however, belies the complexity involved in Saab's survival and how that affects the Swedish government's desire to maintain indirect control of the firm. We will now explore some of these issues as Saab has evolved from the turn of the century up through recent political upheavals in Sweden.

From the decisions in the 1990's to allow FDI, consolidate capabilities in Saab, and support more internationalization and exports in the Swedish DIB, Saab was able to pursue a larger market for its products. This pursuit was critical given Sweden's stagnant defense spending and lower government investments in R&D efforts mentioned earlier. The government levers exercised in the 1990's were lower defense spending, the relaxing of export controls, and encouraging FDI. The firm's response was the pursuit of new markets on the international stage and the development of partnerships with international firms (i.e. BAE, Boeing) that could access these markets. Sweden demonstrated a sophistication in the implementation of these levers that demonstrates an understanding of DIB health issues. As the government recognized it no longer desired or could prop up its DIB across a wide range of capabilities through its own acquisition requirements, it allowed its DIB to compete more successfully in foreign markets. In fact, in 2010 the Swedish government established the Swedish Defense and Security Export Agency (FXM), whose express duties were to promote Swedish defense exports, not the least of which was the Gripen aircraft.³⁸⁷ This demonstrates the deliberate nature of Swedish government policy related to the health of its DIB. There appears to be a tacit understanding in Sweden that pulling certain government levers will affect the DIB and therefore other levers may need to be pulled to effect balance.

There is another lesson of government levers and firm behavior still to be demonstrated. Government levers related to policy are certainly not the sole drivers of firm behavior, especially for firms competing in open, competitive markets. This was demonstrated in the treatment of the submarine

firm Kockums where the foreign purchaser, Germany's HDW, attempted to limit Kockum's market share in order to bolster itself.³⁸⁸ This story illustrates two important points related to Saab and Sweden. First, Sweden's liberalization efforts brought unintended consequences, yet the Swedish government was willing and able to act in a manner that secured their DIB's core capabilities at the desired level. Second, Saab is still intertwined with the Swedish government in that the firm worked to acquire Kockums even though the firm was not necessarily a strong business match as part of an aviation, missile, radar, and technology focused firm. Saab and Sweden are still collaborators, but as will be shown next, recent levers pulled by the Swedish government have created tension between the two actors.

Given the Swedish government policy choices to decrease defense spending while allowing and promoting exports, Saab pursued new markets beyond domestic and Nordic partners. In fact, over the last 20 years Saab moved from near complete dependence on Swedish defense spending to a mix of 60 percent of foreign sales.³⁸⁹ As Saab successfully pursued export markets it was able to sustain profits, maintain its technological edge, and employ thousands of Swedes, all laudable outcomes in maintaining a healthy DIB. However, as mentioned in previous sections, export tradition in Sweden was geared toward arms transfers only to politically palatable countries. Also, the unprecedented coming to power of a coalition government of the Green and the Social Democratic Labor Parties in 2014 changed the export landscape dramatically for Saab. Representing the will of the Swedish people, export policy was revisited with a focus not at all toward DIB health but rather through the lens of what is considered acceptable in Swedish culture. The implementation of more rigorous exporting standards and the dissolving of the FXM were government policies levers pulled in 2014 as a result. This caused Saab to exit lucrative markets, especially Saudi Arabia, the largest arms importer in the world. What is not clear at this point is if the Green/Social Democrat coalition is considering other lever pulls to balance the competitive environment for Saab and other SME's in the Swedish DIB given their restrictions in certain lucrative world markets.

In fact, the Green/Social Democratic coalition is increasing government defense spending as confirmed in Sweden 2016-2020 defense policy white paper. This government lever pull, however, may have little to do with a profound understanding and concern for the health of the DIB. Meetings in Sweden across government, academia, and industry made it clear that Russia is a profound threat to Swedish security necessitating an increase in defense spending in Sweden.³⁹⁰ This is a demonstration of how externalities tend to drive the implementation of government levers. The decision to increase Swedish defense spending is likely based much more on the threat of Russia than the threat of DIB unhealthiness.

Current increased defense spending will increase Sweden's influence on Saab. As Sweden grows as a customer to Saab, it naturally causes Saab to chase host-country's requirements. Conversely, as the Swedish DIB firms chase market share that is increasingly based on foreign country requirements, domestic government influence is relatively decreased. Ultimately firms must compete in the market for survival and their behavior and products are most influenced by the market forces that determine their profitability and market share. Government policies (levers) will affect aspects of their conduct, but absent direct government control or ownership of firms, policy wishes and desires carry weight only to the extent that they are communicated through market forces. In other terms, if a government wants control of a firm's conduct, it must either maintain an ownership stake in the firm or serve as the firm's dominant customer. Since Swedish defense spending constitutes such a small portion of the overall A&D market, it will always struggle to influence its firms through market forces alone.

To summarize, we point to several externalities, government, market, and firm behaviors. First, externalities tend to drive government policy lever decisions. Adversary actions, political ties to other countries, control of technology, and especially financial resource balancing are critical to governments' trying to maintain their security. Some DIB firm perspectives are certainly broadcast back to the government to influence policy. However, the more distant the government-firm relationships are, the more government lever pulls will tend to be driven by the state's security or budget environment rather than direct concern for the health of the DIB. Second, a government can influence firm behavior through two areas, policy levers and money. Policy levers through laws, exports controls, and other regulatory

measures affect firm access to and conduct in markets. Government spending grows government market influence as funding is the primary driver for firm success. This idea was driven by U.S. firms insisting that the best way they can convince investors to provide capital was to demonstrate market demand, often broadcast through the funding of major U.S. government programs. Absent market demand, companies competing in the global A&D market have little incentive to pursue expensive outlays for new products.³⁹¹ Varying government and firm relationships deliver different outcomes. A country that essentially owns its national champion firm can control its conduct, but often suffers in the competitive international environment. Countries such as Sweden that relinquish much control over their DIBs risk the ability to control firm conduct but may, with intelligent lever pulls, be more likely to sustain a competitive DIB. In any case, governments would do well to understand the implications of particular lever pulls meant to deal with the external environment when these choices will also affect critical DIB capabilities.



Diagnosics – DIB Competition (Sweden)

DESIRED ATTRIBUTES OF THE AERO/DEFENSE DIB	Sweden
Portfolio/Contingency Alignment with Industry Partners	
•Level of capability (i.e. Nuclear, Third Offset, Major/Minor Systems, 6th Generation fighter)	Ftr / Sub
•Industrial capability to support the NSS (don't know their NSS?)	Partnerships via tech attractiveness
Value	
•Deliver desired capability at lowest cost	Broke the Cost Curve
•Competition, collaboration	National Champion w/ 2nd Tier Competition
Industrial Surge Capacity	
•How long would it take to have a substantive increase in aircraft production rates	Integration - Moderate / Supply Chain - Poor
Firm Financial Stability	
•Performance of industrial partners is supported by investor capital flows	Strong Future Growth
•Is there a reasonable structure of firms in the DIB	National Champion w/ 2nd Tier Support
•Beneficial externalities generated for the country	Triple Helix: Very Strong
Innovation Toward Maintaining Competitive Advantage	
•National Innovation System available to defense industrial partners	Harmony w/in all industries
•Includes innovation in technology, manufacturing and concepts of operations	Strong for their scope
•Beneficial externalities generated for the country	Strong for their scope
International Influence	
	Punch Above their Weight

The Swedish DIB is generally aligned with Swedish national goals. The level of capability of the DIB in aerospace is as a full integrator of fourth-generation fighter technology as well as advanced missiles and some commitment to unmanned systems. The ability to domestically produce submarines is also impressive for this small country. While impressive, these capabilities are far from comprehensive and represent a narrow spectrum of warfighting capability. Swedish industrial capacity is heavily dependent on imports and global supply chains that present a risk for this non-aligned country in the event that a major conflict disrupts its priority access to imported components.

The Gripen aircraft is a low-cost, modern fourth-generation fighter with low cost to operate. This is due to collaboration between Sweden and Saab to ensure the aircraft can operate in austere conditions with less trained maintenance crews. The tailoring of requirements is the advantage the Sweden/Saab national champion relationship produces, yet this comes at a cost to market performance as there is no competition in the Swedish fighter market.

Saab is expected to be profitable moving forward in all its portfolios. While this is a positive story for the Swedish DIB, the lack of cash flow in the Aeronautics Group for the last few years before 2016 still presents a concern for the firm as it is heavily dependent on cyclical defense spending. Also, DIB firms in Sweden are consistently turning to FDI for financing and M&A activities. Exports are a growing

portion of revenue for these firms. Firm decisions driven mostly by the market are therefore likely to be influenced heavily by forces outside of the country marking a difficult position for the Swedish government. Even with dwindling influence on DIB firms, the spin-off effects are still quite beneficial for Sweden as the DIB employs many Swedes in high paying positions.

The Swedish innovation system is tied directly to defense requirements and firms in innovation clusters spread throughout the country as mentioned earlier. This innovation system is effective in transferring technology to the DIB. This system also allows the Swedish government to “punch above its weight” internationally through partnerships with other countries and technical transfer.

ITALY



Italy Policy Lever Effects



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Although Italy does not have a nuclear weapons capability or the ability to produce a sixth-generation fighter, it does have access to those capabilities through NATO and other global alliances. For example, as a partner with the F-35 program, Leonardo has been provided with the capability for performing final assembly and check out of F-35 aircraft. The first Italian-produced F-35 aircraft flew on September 7, 2015. Italy is actively pursuing access to advanced technologies through global mergers and acquisitions, such as the U.S. firm, DRS Technologies, now operating in the U.S. as a wholly-owned subsidiary of Leonardo.

The two primary firms comprising the Italian DIB, Leonardo (aircraft) and Fincantieri (shipbuilding), have excess capacity to support the Italian NSS. Both companies only generate about 15 percent of revenues from Italian defense and over 85 percent from foreign exports. In the (very) few instances where Leonardo or Fincantieri do not have the capability to produce a particular item the United States is the preferred source, to ensure compatibility with current systems.

Italian DIB firms are challenged with delivering capabilities at lowest cost due to excessive gov't control and regulations. Italian firms deal with very stringent environmental requirements and expensive labor practices. This is rated "yellow" vice "red" because the two primary firms have established production facilities in other countries (e.g., U.S. and U.K.) with less stringent regulations. Gov't ownership also affects costs because Italian Ministries have the power to inject additional requirements into company contracts, e.g. requirements for follow-on contracts and extended production cycles.

Italian firms are well positioned for global collaboration with larger firms (e.g., Boeing, Lockheed Martin, and Airbus). This provides the firms with access to advanced technologies, reduces risks from fluctuations in Italian requirements, and enables the (relatively) smaller firms to compete in the global environment. Because Italian firms such as Leonardo already have production rates much higher than required by the Italian Ministry of Defense, they have the ability to surge when required for defense systems. In the global arena, Leonardo continues to develop production facilities in strategic locations, further expanding their industrial surge capacity.

The Italian Ministry of Economy and Finance owns controlling shares of Leonardo (30 percent) and Fincantieri (72 percent). Defense contracts are executed and funded by the Ministry of Defense. The government implements policies and corporate oversight with the stated primary objective of "financial success." The primary firms in the Italian DIB are structured to focus on core business domains. Leonardo

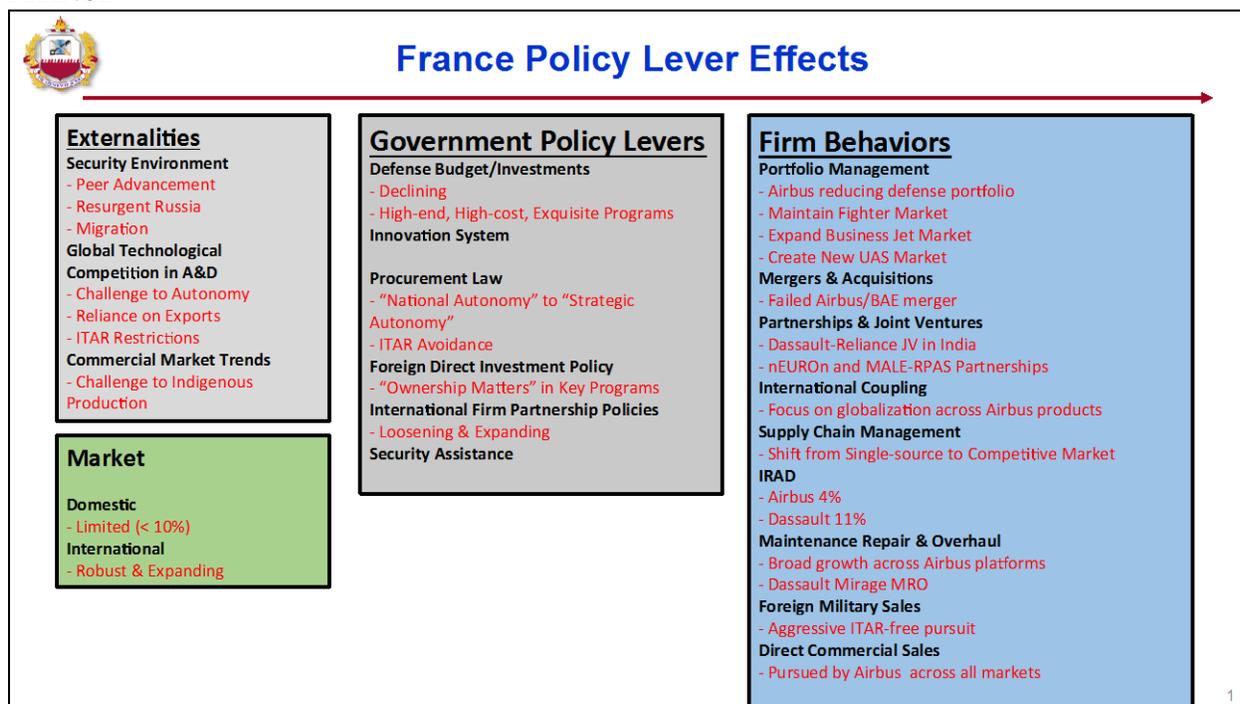
was recently restructured to realign competing divisions, eliminate duplicate efforts, and resolve corporate corruption issues. The firm now operates under a single corporate structure, has divested non-core business elements, and renewed their vision and objectives under the “one company” philosophy.

The global expansion of Italian firms, especially Leonardo, supports the country’s GDP, provides access to new technologies, opens the door for global expansion into emerging markets, and supports a healthy and competitive DIB. The global partnerships provide the opportunity for MRO and Supply Chain markets for other (larger) aircraft firms. Leonardo partnered with the Polytechnic University of Milan to create an “InnovationHub” for promoting cooperation between industry and academia in research, development and innovation. Currently, numerous university research projects related to Leonardo's business areas are underway. Italian firms effectively use mergers and acquisitions for access to advanced technologies, innovations, and other competitively advantageous products and services.

Expanding global influence has allowed Leonardo to bid competitively for the USAF T-X program through their U.S. subsidiary (Leonardo DRS), partner with Lockheed Martin on F-35 final assembly in Italy, partner with Airbus going after the Southeast Asia Maritime Patrol Aircraft, and operate a helicopter production facility in Poland. The Asia-Pacific helicopter market is also a potential area for Leonardo to expand their influence.

DESIRED ATTRIBUTES OF THE AERO/DEFENSE DIB	Italy
Portfolio/Contingency Alignment with Industry Partners	
•Level of capability (i.e. Nuclear, Third Offset, Major/Minor Systems, 6th Generation fighter)	Advanced technologies, supporting F-35 and other high-tech programs. Innovation Hub for R&D of new technologies.
•Industrial capability to support the NSS (don't know their NSS?)	Leonardo has excess capability
Value	
•Deliver desired capability at lowest cost	Cost driven by externalities, e.g. restrictive gov't policies, labor laws, environmental requirements
•Competition, collaboration	Global collaborations, joint ventures, and foreign acquisitions
Industrial Surge Capacity	
•How long would it take to have a substantive increase in aircraft production rates	Excess capacity allows for surges in production
Firm Financial Stability	
•Performance of industrial partners is supported by investor capital flows	Gov't funding from Ministry of Defense and Ministry of Economics and Finance
•Is there a reasonable structure of firms in the DIB	Oligopoly with Leonardo and Fincantieri, both gov't owned.
•Beneficial externalities generated for the country	Some beneficial, some negative externalities
Innovation Toward Maintaining Competitive Advantage	
•National Innovation System available to defense industrial partners	Innovation Hub, partnerships with Universities
•Includes innovation in technology, manufacturing and concepts of operations	Consistent gov't investments in R&D
•Beneficial externalities generated for the country	Global partnerships providing access to advanced technologies
International Influence	Expanding global influence in U.S., UK, and Asia-Pacific

FRANCE



France faces external challenges common to most Western countries, such as rising near-peer and peer threats and mass migrations with accompanying rise in terrorism. However, it also faces threats to its particular form of capitalism and national security autonomy. France’s DIB is highly dependent on exports. As a case in point, 92 percent of Dassault’s 2016 revenue came from export sales. The competitive pressures of globalization and the ever-increasing difficulty of avoiding ITAR-restricted components have challenged France’s historically lucrative – and vital – export competitiveness. Combined, these external pressures have directly challenged and impacted France’s historic “made in France” policies.

The French government has recognized the impact on its DIB and the need for its “national champions” to remain competitive and viable in the international market. Consequently, as previously noted, France has recently shifted from a “national autonomy” policy of full-spectrum indigenous production and internal sole-source French suppliers to a “strategic autonomy” policy of (primarily European) external “best value” suppliers and internationally cooperative ventures. Although loosening its “indigenous” development, supply, and production policies, France has drawn a couple of red lines. First, it remains adamantly opposed to using ITAR-restricted components since they “restrict” France’s potential export markets. Second, the French continue to assert that “ownership matters,” which means that key French capabilities (e.g. nuclear) are simply not for sale or collaboration. Key national security capabilities will remain “in house” regardless of cost.

The French DIB has responded decisively to changing government policies and declining defense spending. A&D industries have “right sized” production capacity and focused their efforts on their most lucrative products, and are shifting from French single-source suppliers to international “best value” suppliers. This has resulted in a significant step away from indigenous fighter aircraft development and production and an aggressive step towards growing civil markets, and, to a lesser degree, towards combat UAV development. As previously noted, the Rafale might very well be the last “all French” fighter produced. In order to maintain or gain an international competitive advantage, French A&D industries have invested significantly in R&D to develop attractive products for FMS and DCS. Finally, they have embraced the move to increase MRO market share in order to broaden their corporate portfolios.



Diagnostics – DIB Competition

DESIRED ATTRIBUTES OF THE AERO/DEFENSE DIB	France
Portfolio/Contingency Alignment with Industry Partners	
• Level of capability (i.e. Nuclear, Major/Minor Systems)	Full Spectrum A2/AD
• Industrial capability to support the NSS	Declining Defense Focus
Value	
• Deliver desired capability at lowest cost	High-end, Exquisite Systems
• Competition, collaboration	National Champions
Industrial Surge Capacity	
• How long would it take to have a substantive increase in aircraft production rates	Designed for Low-rate Production
Firm Financial Stability	
• Performance of industrial partners is supported by investor capital flows	State-sponsored Monopolies
• Is there a reasonable structure of firms in the DIB	Full Spectrum, but "One Each"
• Beneficial externalities generated for the country	Vast Export Market
Innovation Toward Maintaining Competitive Advantage	
• National Innovation System available to defense industrial partners	Symbiotic
• Includes innovation in technology, manufacturing and concepts of operations	
• Beneficial externalities generated for the country	Vast Export Market
International Influence	International Heavyweight

France is a political and economic heavyweight in the EU and the bloc's second largest defense market behind the UK. It has also been an engine of European integration and a strong proponent of greater intra-community defense and security cooperation. It is one of two nuclear-armed states in Europe (along with UK), and – like the UK – a permanent member of the United Nations Security Council.³⁹² France is one of the few European states that seek to maintain full-spectrum military capabilities and related defense technologies and production capabilities – due primarily to the longstanding strategy of military and political independence put in place by Charles de Gaulle. Consistent with its strong Gaullist policy, France developed and produced many of its own military platforms.³⁹³ However, the state's industrial capability to support its NSS is in decline due to steadily declining defense budgets.

France produces some of the world's most advanced A&D products; however, the French A&D industry's "national champion" (monopoly) status and focus on high-end, exquisite markets results in equally exquisite pricing. By design, France's "national champion" industries are relatively free from domestic competition; however, the competitive pressures of globalization have recently forced the country to shift from a "national autonomy" policy of full-spectrum indigenous production and internal sole-source French suppliers to a "strategic autonomy" policy of (primarily European) external "best value" suppliers and internationally cooperative ventures.³⁹⁴

France's A&D industries have responded to declining defense budgets and low domestic demand for new A&D programs by "right sizing" production capacity accordingly, which has effectively eliminated any meaningful near-term surge capacity. For example, every international order for Dassault's Rafale displaces production of a domestic Rafale, since there is no near-term business case justification to increase capacity.³⁹⁵

Overall, France's "national champion" A&D industries are financially stable and cover the spectrum of DIB capabilities - a direct result of predictable long-term government-sponsored monopoly support. This "comfort level" enables the firms to take relatively higher risk in aggressive R&D investment compared to many of their primary "free market" international competitors, which, in turn, results in high-end - highly exportable - products. As a case in point, in 2016 Dassault earned 92 percent of its revenue from exports.³⁹⁶ The "national champion" arrangement has worked well for France and has yielded significant benefits for the country and established France as a key player in the international A&D market.

VIII. DEPENDENCIES AND COUNTER-DEPENDENCIES

Interoperability with U.S. systems is a key requirement for a number of nations, such as NATO member as well as allies farther afield, such as Japan and Australia. The requirement to integrate with U.S. forces at the most basic level as radios, air refueling, and datalinks forces these countries to purchase equipment that may exceed their specific performance needs and defense budgets. They in turn purchase smaller numbers of high-end platforms rather than larger numbers of less capable yet adequate platforms that are not United States in origin. This is an example of how an alliance structure has influenced the procurement decisions of other nations. This effect can also operate in the other direction.

The initial purchase price of a fourth-generation fighter comprises only about 30 percent of the lifecycle cost of the platform. The training, sustainment, logistics, maintenance, and support of that system represents the other 70 percent. All of these supporting factors, in addition to the airframe, differ by country of origin. U.S.-built ground support equipment such as generators and hydraulic servicing carts are not compatible with aircraft of Russian or Chinese origin.

The organizations that operate these platforms also mirror those of the country from which they are procured. Japanese F-15J units are structured almost identically to U.S. fighter squadrons and are therefore markedly different from the organization of Russian or Chinese fighter units. The same is true of differing training and operational doctrine, safety programs, and maintenance practices.

These factors combine to create a technical 'lock-in' effect for subsequent purchases. Once a nation purchases a U.S. platform, it is more likely to purchase follow-on U.S. platforms based on the combined effects of the influences described above. A single arms sale may foster dependencies that last decades. For countries that are not political allies of the United States, arms purchases represent the first alignment between nations along a path to closer ties. There are examples where shifts in governments have armed new adversaries with U.S. weapons (such as Iran) but can also create a strategic advantage for the United States by way of strangling supply chains of critical parts.

Asia and the Pacific, along with the Middle East and North Africa, represent an emerging market for A&D sales. As these countries grow in wealth, so will their appetite for airframes that were previously beyond their means. These nations will buy from whichever supplier will provision them efficiently, and their first purchases will likely 'lock-in' country of origin preferences for years to come. Further political and economic alignment may follow these sales.

Smaller European states, along with China and Russia, have identified arms export sales as key to the health of their DIBs. Such sales may also facilitate regional alliance structures on a longer time horizon. This emerging market may represent a political opportunity to bring growing states into the U.S. orbit using means that require less political coordination and will than do formal treaties or multilateral trade agreements. A helicopter sale to a state such as Indonesia via FMS, direct commercial sale, or security assistance is more easily accomplished than something grandly strategic like the Trans-Pacific Partnership (TPP). Such sales may deliver at least some of the same results or set the conditions for similar results as grand bargains along the line of the TPP because one purchase from the United States can easily beget an enduring relationship.

IX. CONCLUSION

Analysis of individual firms along with visits to major aircraft firms in the United States and Sweden in the spring of 2017 have provided insights into the business and government relationship over the last five years. Firms and government forces on both sides of the Atlantic Ocean show many similarities. While firms in these nations have a phenomenally talented pool of engineers and business leaders as well as some of the most sophisticated facilities in the world, recent pressures have created significant challenges for these firms and for the DIBs in these countries.

Reduction in defense budgets coupled with growing complexity of exquisite weapon systems has had various negative repercussions. This ongoing trend toward complexity under reduced budgets has resulted in massive and highly infrequent programs creating “winner-take-all” conundrums. Given the size and scope of these exquisite weapon systems contracts, failure is not an option for firms if they plan to meet shareholder demands. This creates a shift in risk paradigms with mitigation factors discussed below. Additionally, complexity often results in cost and schedule overruns that continue to undermine the capacity for governments to support a diversity of weapon programs or high quantities of existing systems. Furthermore, for the firms that do not win these massive contracts, there are gross fluctuations in revenues and needed human capital, creating instabilities that undermine the performance of the firm and the health of the DIB in the long-term.

To mitigate the high risks associated with these rare complex weapon system programs and to minimize the vast fluctuations that result from the high amplitude low frequency program sinusoid there are various emergent firm behaviors:

1. **Focus on Exports:** Without internal domestic support for these expensive and exquisite systems and their associated complex production facilities, firms are forced to go to the international market to help increase production quantities that can help fund R&D and capital investment and reduce per unit cost.
2. **Focus on Services:** With many countries going on a procurement holiday when faced with budget reductions there is a need to continue to maintain, rebuild and/or incessantly upgrade existing systems. This market to support the readiness of aging systems has been an alternative means for firms to stabilize revenues when faced with the instability associated with fluctuating defense budgets and infrequent new-start programs.
3. **Focus on Information:** Given the aforementioned difficulty of starting new programs, particularly those that deliver or even modify hardware, firms have elected to offer options to the government that modify software or network existing systems. Often it is possible to provide multiple software upgrades to fielded systems under relatively low cost when compared to the development of an entirely new systems. As such a large part of the innovation has occurred in the information domain.
4. **Focus on Teaming:** Another means of mitigating risk is to share it in a partnership. Such teaming can also be a means of opening other markets to help aid with the foreign sales discussed in #1 above aiding with economies of scale and establishing offsets. This teaming has resulted in ongoing consolidation of competitors that bid on programs and therefore has reduced competition in the DIB.
5. **Incremental Innovation and Limited R&D:** With the high risk of a winner-take-all firms have little incentive to invest in major leaps in technology. This has resulted in ongoing incremental innovation that looks to compete primarily in cost.

Besides the firm efforts to mitigate the risks associated with the government demand for exquisite and infrequent weapon systems, this government decision to develop a portfolio of only high-end exquisite programs has undermined the ability to have a properly balanced “high/low mix” of platforms developed by the DIB. Firms have not been incentivized to create or consider this “low-mix.” To some degree with export controls on high-end technologies, one might think that there would be a low-cost and low-end capability that could be harvested by DoD, but for the most part these systems are more of a “medium-end,” being too expensive for mass procurement, but too cheap to provide the needed sophisticated capabilities. As a result, the export of weapons has served an important role in international relations, but its utility in strengthening the competitiveness of the DIB has come primarily in mitigating the fluctuations in these infrequent DoD programs. That should not detract from the opportunity that these exports provide to influence allied and adversary DIBs under the proper government coordination, but a better focus on a true low-end instead of a medium-end system could even further the export opportunities and potential to influence other DIBs.

Additionally, this growing complexity without a “low mix” hedge creates other risks to the DIB. To some degree it has undermined the surge capacity of the DIB in case there is a need to respond to a high-attrition protracted war. Take for example the global supply chain, extremely long lead time parts, and intricacy of the “one-of-a-kind” production tooling for a new F-35. In case of a protracted war, the time to recognize sufficiently high attrition rates, initiate an industrial surge, and actually start producing at increased numbers would likely take years. The alternative is to build redundant manufacturing capacity and move away from managing supply chains with just-in-time inventory, an approach that would dramatically drive up cost when budgets are already limited. There has been ongoing discussion of DoD needing to incorporate more commercial technologies as well as firms that traditionally do not provide defense systems. However, this insatiable desire for exquisite systems seems to increase cost, which increases bureaucratic oversight, which increases barriers to entry for alternative firms that could provide true competition or radical substitutes to create a more robust competitive advantage. Without a continual stream of new entrants there is a growing risk of isomorphism, where defense industry will mirror the governments hierarchal organizational, undermining the innovation of the DIB.

Fiscal challenges are likely to continue to strain the DoD budget all while the international security environment becomes more complex, demanding a need to maintain a force that can rapidly respond around the globe to a full spectrum of conflict from humanitarian aid, to counter-terror, to high-intensity war. Many of the exquisite systems do not necessarily provide utility to DoD except in high intensity conflict, and in recent history most engagements have been in lower intensity scenarios. What is worse, without low-cost alternative platforms, often these exquisite platforms are being used for low intensity conflict dramatically driving up operations cost and eroding the functional lifespan of the exquisite systems because of unplanned intense use of these very expensive systems attacking very inexpensive targets. Low intensity scenarios provide minimal return on investment for these exquisite assets. With a focus on procuring such systems, resourcing agility is reduced (i.e. resources must be forecast and committed for a certain type of conflict and obviously there are times that these forecasts are not accurate). If there is a dramatic shift in world affairs, DoD remains wedded to assets with multi-decade acquisition timelines even if they provide limited utility. Even more damning is the fact that this unplanned excess use has limited the ability of these platforms to respond to the high-intensity conflicts that they were designed to dominate. Fundamentally, the governments poor “high/low mix” portfolio planning has created vast readiness problems for DoD and has undermined the DIB’s ability to affordably align with the NSS. It seems possible, through improved relationships, for government and industry to collaboratively address this problem and work together to find a solution that is beneficial to all stakeholders.

END NOTES

- ¹ North American Industry Classification System, U.S. Census Bureau, accessed February 5, 2017, <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=336411&search=2017%20NAICS%20Search>.
- ² Bozinovski, Igor, “Belarus to Donate MiG-29s, Buk SAMS to Serbia,” *Jane’s Defense Weekly*, January 31, 2017, accessed February 3, 2017, <https://janes-ihs-com.nduezproxy.idm.oclc.org/Janes/Display/1794925>.
- ³ Washington, Lara Seligman, “Lockheed Martin’s F-35 Gains Steam Globally,” *Aviation Week & Space Technology*, December 23, 2016, accessed February 2, 2017, <http://awin.aviationweek.com.nduezproxy.idm.oclc.org/ArticlesStory.aspx?id=6493df07-2881-4881-b717-4cc52c70bb1b>.
- ⁴ O’Dwyer, Gerard, “Denmark’s Fighter Jet Selection to Likely Cause Political Furor,” *Defense News*, May 15, 2016, accessed February 5, 2017, <http://www.defensenews.com/story/defense/international/europe/2016/05/15/f-35a-fighter-jet-denmark-political/84278388/>.
- ⁵ Jennings, Gareth, Lockheed Martin Sees F-35 Potential in Switzerland, “*Jane’s Defense Weekly*, July 8, 2016, accessed February 2, 2017, <https://janes-ihs-com.nduezproxy.idm.oclc.org/Janes/Display/1773489> and Osborne, Tony, “Fighter Aircraft Procurement Plans of 19 European Countries,” *Aviation Week & Space Technology*, June 29, 2016, accessed February 1, 2017, <http://aviationweek.com/farnborough-airshow-2016/fighter-aircraft-procurement-plans-19-european-countries>.
- ⁶ Pugliese, David, “Canada Wants Super Hornet Jets by 2019, but Costs Still Undecided,” *Defense News*, February 1, 2017, accessed, February 5, 2017, <http://www.defensenews.com/articles/canada-wants-super-hornet-jets-by-2019-but-cost-still-undecided>.
- ⁷ LaGuerre, Cedric and DeVore, Marc, “F-35 Price and Prejudice,” *Defence & Security Analysis*, Vol. 26, No. 3, September 2010, pp. 331-333.
- ⁸ Aboulafia, Richard, “Fighter/Attack Aircraft Overview,” *World Military and Civil Aircraft Briefing*, February 2016, and Washington.
- ⁹ Note: For purposes of calculating HHI for the Euro-Atlantic market, this paper has made use of market share statistics from the Lara Washington piece in *Aviation Week & Space Technology*. Although those statistics are for the world market, they exclude the other major players – Russia and China – and therefore provide an adequate proxy.
- ¹⁰ Hartley, Keith, *The Political Economy of Aerospace Industries*, Cheltenham, UK and Northampton, MA: Edward Elgar, 2014, pp. 79-80.
- ¹¹ Aboulafia, and Washington.
- ¹² Porter, Michael E., “The Five Competitive Forces that Shape Strategy,” *Harvard Business Review*, January 2008, pp. 80-85.
- ¹³ DeVore, Marc and Moritz, Weiss, “Who’s in the Cockpit? The Political Economy of Collaborative Aircraft Decisions,” *Review of International Political Economy*, Vol. 21, No. 2, 2014, pp. 507-510.
- ¹⁴ LaGuerre, Cedric, “Is the Defense Market Contestable? The Case of Military Aerospace,” *Defense and Peace Economics*, Vol. 20(4), August 2009, p. 317.
- ¹⁵ Heinrich, Markus N., “The Eurofighter Typhoon Programme: Economic and Industrial Implications of Collaborative Defence Manufacturing,” *Defence Studies*, Vol. 15, No. 4, 2015, pp. 353-354.
- ¹⁶ Hartley, pp. 61-63.
- ¹⁷ Defence Expenditures of NATO Countries (2009-2016), NATO Public Diplomacy Division, July 4, 2016, accessed February 6, 2017, http://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2016_07/20160704_160704-pr2016-116.pdf.
- ¹⁸ LaGuerre, pp. 308-309.
- ¹⁹ *World Unmanned Aerial Vehicle Systems*, Executive Summary, Teal Group Inc, 2015, pp. 11-12.
- ²⁰ Joshi, Shashank and Stein, Aaron, “Emerging Drone Nations,” *Survival*, Vol. 55, No. 5, October-November 2013, pp 55-59.
- ²¹ Sequin, Barre, “Why Did Poland Choose the F-16?,” *George C. Marshall Center Occasional Paper 11*, June 2007, pp. 18-22.
- ²² LaGuerre, pp. 305 and 307.

-
- ²³ Gansler, Jacques, *Democracy's Arsenal: Creating a Twenty-First Century Defense Industry*, Cambridge, MA and London: MIT Press, 2011, pp. 140-143.
- ²⁴ Heinrich, pp. 347, 349, and 354.
- ²⁵ Aboulafia, pp. 2-3 and 8.
- ²⁶ *Ibid.*, pp. 2-3/
- ²⁷ *Ibid.*, pp. 10-12.
- ²⁸ *Ibid.*, p. 8 and Washington.
- ²⁹ Osborne.
- ³⁰ This number is for 2015 dollars. All budgets for the Soviet Union are estimates. Stockholm International Peace Research Institute, "SIPRI Arms Transfers Database," February 2017, <https://www.sipri.org/databases/armstransfers>.
- ³¹ Ron Matthews and Alma Lozano, "The Mercurial Development of Russia's United Aircraft Corporation," *Defense & Security Analysis* 28, no. 2 (June 1, 2012): 4, doi:10.1080/14751798.2012.678158.
- ³² *Ibid.*
- ³³ Julian Cooper, "The Military Dimension of a More Militant Russia," *Russian Journal of Economics* 2, no. 2 (June 2016): 129-45, doi:10.1016/j.ruje.2016.06.002.
- ³⁴ *Ibid.*
- ³⁵ *Ibid.*, 5.
- ³⁶ *Ibid.*, 6.
- ³⁷ Cooper, "The Military Dimension of a More Militant Russia."
- ³⁸ Matthews and Lozano, "The Mercurial Development of Russia's United Aircraft Corporation," 152.
- ³⁹ *Ibid.*
- ⁴⁰ *Ibid.*, 155.
- ⁴¹ Stockholm International Peace Research Institute, "SIPRI Arms Transfers Database."
- ⁴² Matthews and Lozano, "The Mercurial Development of Russia's United Aircraft Corporation," 156.
- ⁴³ *Ibid.*
- ⁴⁴ Matthews and Lozano, "The Mercurial Development of Russia's United Aircraft Corporation," 163.
- ⁴⁵ *Ibid.*, 164.
- ⁴⁶ Guy Anderson and Paul Burton, "Navigating the Emerging Markets, Russian Federation," February 2017, 14.
- ⁴⁷ Anderson and Burton, "Navigating the Emerging Markets, Russian Federation."
- ⁴⁸ Cooper, "The Military Dimension of a More Militant Russia," 7.
- ⁴⁹ *Ibid.*, 26.
- ⁵⁰ *Ibid.*
- ⁵¹ Keith Crane, "The Effectiveness of China's Industrial Policies in Commercial Aviation Manufacturing," 2014, <https://www.rand.org/pubs/testimonies/CT416.html>.
- ⁵² *Ibid.*, 4.
- ⁵³ Tai Ming Cheung, "The Chinese Defense Economy's Long March from Imitation to Innovation," *Journal of Strategic Studies* 34, no. 3 (June 1, 2011): 325-54, doi:10.1080/01402390.2011.574976.
- ⁵⁴ *Ibid.*
- ⁵⁵ Tate Nurkin, "Chinese Aerospace and Defense," March 29, 2017.
- ⁵⁶ Cheung, "The Chinese Defense Economy's Long March from Imitation to Innovation."
- ⁵⁷ "The Gathering Pacific Storm," 4.
- ⁵⁸ Michael Raska, "China's Defence Aviation Industry: Searching For Innovation – Analysis," *Eurasia Review*, October 18, 2012, <http://www.eurasiareview.com/18102012-chinas-defence-aviation-industry-searching-for-innovation-analysis/>.
- ⁵⁹ Cheung, "The Chinese Defense Economy's Long March from Imitation to Innovation," 325-54.
- ⁶⁰ "The Gathering Pacific Storm," 7.
- ⁶¹ Richard Connolly and Cecilie Sendstad, "Russia's Role as an Arms Exporter: The Strategic and Economic Importance of Arms Exports for Russia" (Chatham House, March 2017), 15, <https://www.chathamhouse.org/node/28521>.
- ⁶² *Ibid.*
- ⁶³ Stockholm International Peace Research Institute, "SIPRI Arms Transfers Database."
- ⁶⁴ Raska, "China's Defence Aviation Industry," 18.

-
- ⁶⁵ Lundmark, Martin, “Absorbing New Military Capabilities: Defense Technology Acquisition and the Asia-Pacific,” in Bitzinger, Richard and Vlavianos, Haris, *Emerging Critical Technologies and Security in the Asia-Pacific*, London: Palgrave Macmillan, 2016, pg. 39.
- ⁶⁶ DeVore, Marc R. and Weiss, Moritz, “Who’s in the Cockpit? The Political Economy of Collaborative Aircraft Decisions,” *Review of International Political Economy*, 2014, Vol. 21, No. 2, pp. 497-533.
- ⁶⁷ Hampden-Turner, Charles and Trompenaars, Alfons, “Sweden’s Social Individualism: Between Raging Horses,” *The Seven Cultures of Capitalism: Values Systems for Creating Wealth in the United States, Japan, Germany, France, Britain, Sweden and the Netherlands*, New York: Doubleday, 1993, pp. 233-260.
- ⁶⁸ DeVore, Marc R., “Defying Convergence: Globalization and Varieties of Defense-Industrial Capitalism,” *New Political Economy*, 2015, Vol. 20, No. 4, pg. 570.
- ⁶⁹ Lazaric, Nathalie, Merindol, Valerie, and Rochhia, Sylvie, “Changes in the French Defense Innovation System: New Roles and Capabilities for the Government Agency for Defense,” *Industry and Innovation*, 2011, Vol. 18, No. 5, pg. 5.
- ⁷⁰ DeVore, Marc R., “Arms Production in the Global Village: Options for Adapting to Defense-Industrial Globalization,” *Security Studies*, 2013, Vol. 22, No. 3, pg. 537.
- ⁷¹ DeVore (2013), pg. 537. See also DeVore (2015), pg. 578, where the example of Israel’s inability to bear the costs of developing the Lavi fighter to succeed the Kfir was particularly illustrative.
- ⁷² Bialos, Jeffrey P., Fisher, Christine E., and Koehl, Stuart L., *Fortresses and Icebergs: The Evolution of the Transatlantic Defense Market and the Implications for U.S. National Security Policy*, Volume II, Country Studies, Washington: Center for Transatlantic Relations, School of Advanced International Studies, the John Hopkins University and the U.S. Department of Defense, 2009, pg. 561.
- ⁷³ “Navigating the Emerging Markets - United Kingdom,” IHS Jane’s Navigating the International Markets,” February 17, 2017, pg. 12.
- ⁷⁴ “Navigating the Emerging Markets - United Kingdom,” pg. 12.
- ⁷⁵ “Navigating the Emerging Markets - United Kingdom,” pg. 47.
- ⁷⁶ “Navigating the Emerging Markets - United Kingdom,” pg. 13.
- ⁷⁷ Bialos et al., pg. 580.
- ⁷⁸ Bialos et al., pg. 580.
- ⁷⁹ Bialos et al., pp. 613-614.
- ⁸⁰ Bialos et al., pg. 615.
- ⁸¹ Bialos et al., pp. 593 and 562.
- ⁸² Bialos et al., pg. 577.
- ⁸³ Bialos et al., pg. 584.
- ⁸⁴ Bialos et al., pg. 579.
- ⁸⁵ DeVore and Weiss, pg. 506.
- ⁸⁶ DeVore and Weiss, pp. 506-507.
- ⁸⁷ DeVore and Weiss, pg. 510.
- ⁸⁸ “Navigating the Emerging Markets - United Kingdom,” pg. 37.
- ⁸⁹ “Navigating the Emerging Markets - United Kingdom,” pg. 13.
- ⁹⁰ “Navigating the Emerging Markets - United Kingdom,” pg. 40.
- ⁹¹ Bialos et al., pg. 565.
- ⁹² “Navigating the Emerging Markets - United Kingdom,” pg. 41.
- ⁹³ Bialos et al., pg. 583.
- ⁹⁴ Finnegan, Philip, “BAE Systems plc,” *Defense & Aerospace Companies Briefing*, Teal Group Corporation, September 2015, pg. 1.
- ⁹⁵ Bialos et al., pg. 591.
- ⁹⁶ Bialos et al., pg. 581.
- ⁹⁷ Bialos et al., pg. 593.
- ⁹⁸ Bialos et al., pg. 562.
- ⁹⁹ See “Navigating the Emerging Markets - United Kingdom,” pg. 41 and Bialos et al., pg. 591 for examples of the priority areas in which the UK has planned to focus over time.
- ¹⁰⁰ Watts, Nick, “Analysis: Anticipating the UK’s Defense-Industrial Policy ‘Refresh’”, *Jane’s Defense Weekly*, February 24, 2016, pg. 2.
- ¹⁰¹ Alic, John A., *Beyond Spinoff: Military and Commercial Technologies in a Changing World*, Cambridge: Harvard Business Press, 1992, pg. 219.
- ¹⁰² World Bank 2015 figures, accessed April 17, 2017, <http://databank.worldbank.org/data/download/GDP.pdf>.

-
- ¹⁰³ “Navigating the Emerging Markets - Sweden,” IHS Jane’s Navigating the International Markets, February 24, 2017, pg. 15.
- ¹⁰⁴ Lundmark, pg. 46
- ¹⁰⁵ Bialos et al., pg. 527.
- ¹⁰⁶ DeVore, Marc R., “Reinventing the Arsenal: Defense-Industrial Adaptation in Small States,” *The Korean Journal of Defense Analysis*, Vol. 28, No. 1, March 2016, pg. 38.
- ¹⁰⁷ DeVore (2016), pg. 41.
- ¹⁰⁸ Alic, pg. 219.
- ¹⁰⁹ Bialos et al., pp. 554-555.
- ¹¹⁰ Alic, pg. 219.
- ¹¹¹ Bialos et al., pg. 527. See the discussion regarding Swedish reliance on U.S. defense technology from World War II throughout the Cold War.
- ¹¹² DeVore (2015), pg. 582.
- ¹¹³ DeVore (2016), pg. 39.
- ¹¹⁴ DeVore (2013), pg. 568.
- ¹¹⁵ DeVore (2016), pg. 39.
- ¹¹⁶ DeVore (2015), pg. 582.
- ¹¹⁷ Bialos et al., pg. 527.
- ¹¹⁸ DeVore (2016), pg. 42.
- ¹¹⁹ Bialos et al., pg. 553.
- ¹²⁰ Bialos et al., pg. 554.
- ¹²¹ Bialos et al., pg. 528.
- ¹²² DeVore (2016), pg. 40.
- ¹²³ Fleurant, Aude et al., *Trends in International Arms Transfers*, SIPRI Fact Sheet, February 2017, pg. 2, accessed April 20, 2017, <https://www.sipri.org/publications/2017/sipri-fact-sheets/trends-international-arms-transfers-2016>.
- ¹²⁴ DeVore (2016), pp. 38-39 and Bialos et al., pg. 541.
- ¹²⁵ Lundmark, pg. 37.
- ¹²⁶ Hagelin, Bjorn, “From Certainty to Uncertainty: Sweden’s Armaments Policy in Transition,” in Markowski, Stefan et al., *Defense Procurement and Industry Policy: A Small Country Perspective*, New York and London: Routledge, 2010, pg. 92.
- ¹²⁷ DeVore (2015), pg. 585.
- ¹²⁸ DeVore (2016), pg. 41.
- ¹²⁹ Lundmark, pg. 44.
- ¹³⁰ Bialos et al., pg. 553.
- ¹³¹ DeVore (2016), pg. 40.
- ¹³² “Sweden - Defense Industry”, IHS Jane’s World Defense Industry, February 23, 2017, pg. 6.
- ¹³³ Marrone, Alessandro and Ungarno, Alessandro, “Relations between the United States of America and Italy in the Post-Cold War Period: A Defense-Industrial Perspective,” *Cahiers de la Méditerranée*, Vol 88, 2014, pp. 18-19.
- ¹³⁴ Jane’s Navigating the Emerging Markets: Italy, IHS Jane’s, July 2016, pg. 8.
- ¹³⁵ Jane’s Navigating the Emerging Markets: Italy, pg. 8.
- ¹³⁶ Caruso and Locatelli, pg. 96.
- ¹³⁷ Camporini, Vincenzo, de Zan, Tommaso, Marrone, Alessandro, Nones, Michele, Ungarno, Alessandro, *The Role of Italian Fighter in Crisis Management Operations: Needs and Trends*, Rome: Edizioni Nuova Cultura, 2014, pg. 91.
- ¹³⁸ Camporini, de Zan, et al, pg. 87.
- ¹³⁹ Finnegan, Philip, “Finmeccanica,” *Defense & Aerospace Companies Briefing*, Teal Group Corporation, October 2015, pg 2 and Jane’s Navigating the Emerging Markets: Italy, pg. 3.
- ¹⁴⁰ Jane’s Navigating the Emerging Markets: Italy, pp. 34-35.
- ¹⁴¹ Jane’s Navigating the Emerging Markets: Italy, pp. 9 and 26.
- ¹⁴² Caruso and Locatelli, pg. 96.
- ¹⁴³ Jane’s Navigating the Emerging Markets: Italy, pg. 26.
- ¹⁴⁴ Felice, Emanuele, “State Ownership and International Competitiveness: The Italian Finmeccanica from Alfa Romeo to Aerospace and Defense (1947-2007),” *Enterprise & Society*, Vol. 11, No. 3, September 2010, pg. 599.

-
- ¹⁴⁵ Felice, pp. 627-628.
- ¹⁴⁶ Caruso and Locatelli, pg. 100.
- ¹⁴⁷ Bialos et al., pg. 436.
- ¹⁴⁸ Bialos et al., pg. 400.
- ¹⁴⁹ Kington, Tom, "Leonardo CEO Moretti out, Replaced by Italian Banking Exec," *Defense News*, March 18, 2017, accessed, April 17, 2017, http://www.defensenews.com/articles/leonardo-ceo-moretti-out-replaced-by-italian-banking-exec?utm_source=Sailthru&utm_medium=email&utm_campaign=Breaking%20News-%203-18&utm_term=Editorial%20-%20Breaking%20News.
- ¹⁵⁰ Finnegan, "Finmeccanica," pg 2.
- ¹⁵¹ Bialos et al., pg. 400.
- ¹⁵² Bialos et al., pg. 431.
- ¹⁵³ Camporini, Vincenzo, Darnis, Jean-Pierre, Marrone, Alessandro, Silvestri, Stefano, Ungarno, Alessandro, *The White Paper: A Strategy for Italy's Defense Policy*, Istituto Affari Internazionale, Document 15/09E, June 2015, pp. 16-17.
- ¹⁵⁴ Camporini, Darnis, et al., pg. 15-17.
- ¹⁵⁵ Felice, pg. 600.
- ¹⁵⁶ Bialos et al., pg. 421.
- ¹⁵⁷ Felice, pg. 596.
- ¹⁵⁸ Felice, pp. 623-624.
- ¹⁵⁹ Felice, pg. 600 and graph on pg. 605.
- ¹⁶⁰ Felice, pg. 608.
- ¹⁶¹ Felice, pg. 626.
- ¹⁶² Marrone and Ungarno, pg. 16.
- ¹⁶³ Camporini, de Zan et al., pg. 93.
- ¹⁶⁴ Marrone and Ungarno, pg. 17.
- ¹⁶⁵ Jane's Navigating the Emerging Markets: Italy, pp. 34-35.
- ¹⁶⁶ Marrone and Ungarno, pg. 17.
- ¹⁶⁷ Marrone and Ungarno, pg. 3.
- ¹⁶⁸ Camporini, de Zan, et al., pg. 120.
- ¹⁶⁹ Camporini, de Zan, et al., pg. 122.
- ¹⁷⁰ Felice, pg. 623.
- ¹⁷¹ Camporini, de Zan, et al., pg. 124.
- ¹⁷² Nones, Michael, Gasparini, Giovanni, and Marrone, Alessandro, *Europe and the F-35 Joint Strike Fighter Program*, Rome: Quaderni IAI, 2009, pg. 52.
- ¹⁷³ Marrone and Ungarno, pp. 2-3.
- ¹⁷⁴ Bialos et al., pg. 421.
- ¹⁷⁵ Bialos et al., pg. 414.
- ¹⁷⁶ Caruso, Raul and Locatelli, Andrea, "Company Survey Series II: Finmeccanica amid International Market and State Control: A Survey of Italian Defense Industry," *Defense and Peace Economics*, Vol. 24, No. 1, 2013, pg. 101 and Finnegan, "Finmeccanica," pg. 1.
- ¹⁷⁷ Marrone and Ungarno, pg. 18.
- ¹⁷⁸ Bialos et al., pg. 400.
- ¹⁷⁹ Jane's Navigating the Emerging Markets: Italy, pg. 36.
- ¹⁸⁰ Caruso and Locatelli, pg. 101 and Finnegan, "Finmeccanica," pg. 1.
- ¹⁸¹ Finnegan, "Finmeccanica," pg. 7 and "Finmeccanica: Company Profile, *MarketLine*, December 8, 2016, pg 24.
- ¹⁸² Jane's Navigating the Emerging Markets: Italy, pg. 24.
- ¹⁸³ *MarketLine*, pp. 30-31.
- ¹⁸⁴ Felice, pg. 609.
- ¹⁸⁵ Finnegan, "Finmeccanica," pg 2.
- ¹⁸⁶ World Bank 2015 figures, accessed April 17, 2017, <http://databank.worldbank.org/data/download/GDP.pdf>.
- ¹⁸⁷ Anderson, Guy and Burton, Paul, *Navigating the International Markets: France*, HIS Jane's, December 2016, pp. 8 and 16.
- ¹⁸⁸ Anderson and Burton, pg. 8.
- ¹⁸⁹ Anderson and Burton, pg. 8.
- ¹⁹⁰ Anderson and Burton, pg. 8.
- ¹⁹¹ Fleurant et al., pg. 2.

-
- ¹⁹² Anderson and Burton, pg. 8.
- ¹⁹³ DeVore and Weiss, pg. 505.
- ¹⁹⁴ Anderson and Burton, pg. 26.
- ¹⁹⁵ Anderson and Burton, pg. 25.
- ¹⁹⁶ Anderson and Burton, pg. 25.
- ¹⁹⁷ Lundmark, Martin and Giovachini, Laurent, *The Development of the French Defense Industry in the 20th Century*, Swedish Defense Research Agency, Base Data Report FOI-R-1573-SE, January 2005, pg. 20.
- ¹⁹⁸ DeVore and Weiss, pg. 499.
- ¹⁹⁹ Jane's Defense Market, pg. 25.
- ²⁰⁰ Lundmark and Giovachini, pg. 19.
- ²⁰¹ Moura, Sylvain and Oudot, Jean-Michel, "Performances of the Defense Industrial Base in France: The Role of Small and Medium Enterprises," *Defense and Peace Economics*, June 2016, pg. 10.
- ²⁰² Moura and Oudot, pg. 13.
- ²⁰³ Moura and Oudot, pg. 10.
- ²⁰⁴ Bialos et al., pg. 334.
- ²⁰⁵ DeVore and Weiss, pg. 510.
- ²⁰⁶ DeVore and Weiss, pg. 507.
- ²⁰⁷ DeVore and Weiss, pg. 499.
- ²⁰⁸ Lundmark and Giovachini, pg. 15.
- ²⁰⁹ DeVore (2015), pg. 583.
- ²¹⁰ Bialos et al., pg. 311.
- ²¹¹ Lundmark and Giovachini, pg. 17.
- ²¹² Markusen, Ann and Serfati, Claude, "Remaking the Military Industrial Relationship: A French-American Comparison," *Defense and Peace Economics*, Vol. 11, June 1999, pg. 276.
- ²¹³ Markusen and Serfati, pg. 276.
- ²¹⁴ Bialos et al., pg. 310.
- ²¹⁵ Lungu, Sorin, "The U.S. Military-Technological Revolution and the "Europeanization" of the French Defense Industrial Sector in the 1990s," *RUSI Journal*, February 2004, pg. 59.
- ²¹⁶ Markusen and Serfati, pg. 292.
- ²¹⁷ Lundmark and Giovachini, pg. 19.
- ²¹⁸ Lundmark and Giovachini, pg. 19.
- ²¹⁹ Bialos et al., pg. 344.
- ²²⁰ Bialos et al., pg. 307.
- ²²¹ Joana, Jean and Smith, Andy, "Changing French Military Procurement Policy: The State, Industry, and "Europe" in the Case of the A400M," *Western European Politics*, Vol. 29, No. 1, pg. 77.
- ²²² Lungu, pg. 62.
- ²²³ DeVore and Weiss, pg. 501.
- ²²⁴ Bialos et al., pp. 324-325.
- ²²⁵ Lazaric et al., pg. 9.
- ²²⁶ Joana and Smith, pg. 77.
- ²²⁷ Lundmark and Giovachini, pg. 21.
- ²²⁸ Anderson and Burton, pg. 35.
- ²²⁹ Joana and Smith, pg. 76.
- ²³⁰ Joana and Smith, pg. 79.
- ²³¹ Joana and Smith, pg. 80.
- ²³² Lundmark and Giovachini, pg. 18. Defense products accounted for 31 percent of French industrial exports in 1990.
- ²³³ Joana and Smith, pg. 79.
- ²³⁴ Anderson and Burton, pg. 8.
- ²³⁵ Bialos et al., p. 325.
- ²³⁶ Camporini, de Zan et al., pg. 103.
- ²³⁷ Markusen and Serfati, pg. 275.
- ²³⁸ Bialos et al., pg. 422.
- ²³⁹ Keith Hartley, "The Political Economy of Aerospace Industries: A Key Driver of Growth and International Competitiveness??" (Northampton, MA: Edward Elgar Publishing, 2014), 142.
- ²⁴⁰ *ibid.*

-
- ²⁴¹ Biography.com Editors, "Margaret Thatcher Biography.com," A&E Television Networks, accessed April 22, 2017 Margaret Thatcher Biography.com, <http://www.biography.com/people/margaret-thatcher-9504796>.
- ²⁴² Hartley, 143 (referencing Parker 2009).
- ²⁴³ *ibid.*
- ²⁴⁴ Leslie Wayne, "The Shrinking Military Complex; After the Cold War, the Pentagon Is Just Another Customer," *New York Times* (online), February 27, 1998, accessed April 22, 2017, <http://www.nytimes.com/1998/02/27/business/shrinking-military-complex-after-cold-war-pentagon-just-another-customer.html>.
- ²⁴⁵ Hartley, 144.
- ²⁴⁶ *ibid.*, 145.
- ²⁴⁷ *ibid.*
- ²⁴⁸ *ibid.*, 146.
- ²⁴⁹ *ibid.*
- ²⁵⁰ BAE Systems, BAE Systems Annual Report 2011, February 2012, accessed April 20, 2017, www.baesystems.com/en/download-en/20151109144309/1434554725864.pdf, iii-iv.
- ²⁵¹ BAE Systems, BAE Systems Annual Report 2011, February 2012, accessed April 20, 2017, www.baesystems.com/en/download-en/20151109144309/1434554725864.pdf, 6.
- Note- Data and figures for 2011 were taken from the Annual report or Preliminary Report. In the case of a discrepancy, the annual report (published later) was used.
- ²⁵² BAE Systems, BAE Systems Annual Report 2012, March 2013, accessed April 23, 2017, <http://investors.baesystems.com/~media/Files/B/Bae-Systems-Investor-Relations-V3/Annual%20Reports/BAE-annual-report-final.pdf>, 4.
- ²⁵³ *ibid.*
- ²⁵⁴ MarketLine, "BAE Systems plc and EADS-Why the merger failed and what happened next," June 2013, accessed April 23, 2017, available on blackboard.ndu.edu, 12.
- ²⁵⁵ *ibid.*, 40.
- ²⁵⁶ Jamie Nimmo, Skylon: Has the commercial space race finally hit escape velocity?" *UK independent* (online), November 3, 2015, accessed April 22, 2017, <http://www.independent.co.uk/news/science/has-the-commercial-space-race-finally-hit-escape-velocity-a6718861.html>.
- ²⁵⁷ Marc R. Devore, "Arms Production in the Global Village: Options for Adapting to Defense-Industrial Globalization," *Security Studies* 22, no. 3 (Jul, 2013), 562. doi:10.1080/09636412.2013.816118.
- ²⁵⁸ Björn Hagelin, *The Margins of Security: Politics and Economics in Sweden*, Elsevier Scientific Publishing Company, 1978, 209.
- ²⁵⁹ Marc Devore, "Defying Convergence: Globalisation and Varieties of Defence-Industrial Capitalism," *New Political Economy* 20, no. 4 (2015), 582.
- ²⁶⁰ Gunnar Eliasson, ed., *Advanced Public Procurement as Industrial Policy, the Aircraft Industry as a Technical University* (New York: Springer, 2010), 81.
- ²⁶¹ Eliasson, *Advanced Public Procurement as Industrial Policy, the Aircraft Industry as a Technical University*, 84.
- ²⁶² Devore, *Defying Convergence: Globalisation and Varieties of Defence-Industrial Capitalism*, 585
- ²⁶³ Saab AB, *IHS Janes*, 2017, 39.
- ²⁶⁴ Björn Hagelin, "Saab, British Aerospace and the JAS 39 Gripen Aircraft Joint Venture," *European Security* 7, no. 4 (12, 1998), 106.
- ²⁶⁵ *The Amazing Fighter Jet Race*, Internet, directed by Bharat Karnad Security Wise, 2017) also available at <https://bharatkarnad.com/2017/03/05/tejas-single-engined-aircraft-debate/>
- ²⁶⁶ Erik Jannesson, Erik Nilsson and Birger Rapp, *Strategy, Control and Competitive Advantage* (Berlin, Germany: Springer-Verlag, 2014), 33.
- ²⁶⁷ Discussions with various industry players in April, 2017 yielded emphatic agreement that the Brazil deal opened new markets and that the T-X competition represented a North American market opportunity. Both deals were perceived to yield an opportunity to sell products across the wider markets in these areas.
- ²⁶⁸ Hagelin, Saab, British Aerospace and the JAS 39 Gripen Aircraft Joint Venture, 106-107
- ²⁶⁹ Saab AB: *Can the Gripen NG Fighter be an Exporting Success?* (London, United Kingdom: MarketLine, 2014), 14.
- ²⁷⁰ *Ibid.*
- ²⁷¹ *Company Profile: Saab AB* (London, United Kingdom: MarketLine, 2017), 58.

- ²⁷² The “Triple Helix” was described in healthy detail during April visits with industry, government, and academic representatives in Sweden. The pride in their innovative culture is evidenced throughout the Swedish Innovation Strategy and in many conversations with the above-mentioned representatives.
- ²⁷³ Devore, *Defying Convergence: Globalisation and Varieties of Defence-Industrial Capitalism*, 4.
- ²⁷⁴ Bombardier Global 6000 GlobalEye Variant, IHS Janes, 2017, 2.
- ²⁷⁵ Saab AB, 5.
- ²⁷⁶ Annual Report 2013: Advantage SAAB: Innovative and Efficient Solutions (Stockholm, Sweden: SAAB Group, 2014), 49.
- ²⁷⁷ Aboulafia, *Market Overviews: Fighter/Attack Aircraft*, 15.
- ²⁷⁸ Marketline Company Profile. “Finmeccanica SpA.” Dec 2016. p. 16.
- ²⁷⁹ Jane’s Report. “Leonardo.” IHS Markit. Jan 2017.
- ²⁸⁰ Philip Finnegan. “Finmeccanica.” Defense & Aerospace Companies Briefing, Teal Group. Oct 2015. p. 18.
- ²⁸¹ BMI Research Report. “2017 Italy Defence & Security Report.” pp. 12-13.
- ²⁸² Jeffrey Bialos, Christine Fisher, Stuart Koehl. “Accessing the Italian Defense Market.” *Fortresses and Icebergs*, Ch. 9. Oct 2009. p. 399.
- ²⁸³ Markeline Report. “Leonardo and PGZ to cooperate on helicopter production for Polish Armed Forces.” Mar 2017.
- ²⁸⁴ Tom Kington. “Leonardo CEO Moretti out, replaced by Italian banking exec.” Defense News. Mar 18, 2017. <http://www.defensenews.com/articles/leonardo-ceo-moretti-out-replaced-by-italian-banking-exec>. Accessed: Apr 21, 2017.
- ²⁸⁵ Tom Kington. “Leonardo CEO defiant on his role in company turnaround.” Defense News. Mar 15, 2017. <http://www.defensenews.com/articles/leonardo-ceo-defiant-on-his-role-in-company-turnaround>. Accessed: Apr 22, 2017.
- ²⁸⁶ Francesco Badde, Francesca Bitondo, Paola Sartori. “DEFENCE BUDGETS AND INDUSTRY: TABLES AND GRAPHS July 2016.” Istituto Affari Internazionali. July 2016. <http://www.iai.it/sites/default/files/tabelle-grafici-en.pdf>. Accessed May 11, 2017.
- ²⁸⁷ 2016 Annual Financial Report. Leonardo SpA. pp. 17, 18, 163.
- ²⁸⁸ David Carl. “Leonardo legally challenges Canada’s FWSAR decision.” IHS Janes Weekly. Feb 25, 2017.
- ²⁸⁹ Greg Waldron. “Leonardo seeks Asia-Pacific inspiration.” *Flight International*. Vol 190, Issue 5552. Aug 23, 2016.
- ²⁹⁰ 2016 Annual Financial Report. Leonardo SpA. p. 59.
- ²⁹¹ Leonardo Press Release. “Leonardo and Polytechnic University of Milan: cutting edge technologies for the aerospace systems of the future.” Mar 27, 2017. 2017.
- ²⁹² Jane’s Report. “Navigating the Emerging Markets: Italy.” p. 37.
- ²⁹³ 2016 Annual Financial Report. p. 8.
- ²⁹⁴ Tom Kington. “Leonardo CEO defiant on his role in company turnaround.” Defense News. Mar 15, 2017.
- ²⁹⁵ Tom Kington. “Leonardo CEO Moretti out, replaced by Italian banking exec.” Defense News. Mar18, 2017.
- ²⁹⁶ Mauro Maretti, Gian Cutillo. “FY 2016 Results & 2017-2021 Industrial Plan.” Leonardo, London. Mar 16, 2017.
- ²⁹⁷ “Company Profile: Dassault Aviation S.A., Reference Code: 2A941F2A-F835-4F99-81D8-5ECD8E730EC6,” MarketLine (November 10, 2016), 3.
- ²⁹⁸ “Company Profile: Dassault Aviation S.A.,” 3.
- ²⁹⁹ “Dassault Aviation,” Jane’s by IHS Markit, 2.
- ³⁰⁰ “Dassault Aviation,” 2.
- ³⁰¹ “Company Profile: Dassault Aviation S.A.,” 4.
- ³⁰² “Company Profile: Dassault Aviation S.A.,” 4.
- ³⁰³ “Dassault Aviation,” 3.
- ³⁰⁴ “Dassault Aviation,” 3.
- ³⁰⁵ “Dassault Aviation,” 3.
- ³⁰⁶ Richard Aboulafia, “World Military & Civil Aircraft Briefing - Market Overviews; Fighter/Attack, Dassault Aviation Rafale,” Teal Group Corporation (October 2016), 5.
- ³⁰⁷ Aboulafia, “Market Overviews; Fighter/Attack, Dassault Aviation Rafale,” 7.
- ³⁰⁸ Aboulafia, “Market Overviews; Fighter/Attack, Dassault Aviation Rafale,” 8.
- ³⁰⁹ Aboulafia, “General Aviation/Utility, Dassault Aviation FALCON Series,” 9.
- ³¹⁰ Anderson, “Navigating the International Markets,” 20.
- ³¹¹ Richard Aboulafia, “World Military & Civil Aircraft Briefing - Market Overviews; Fighter/Attack Aircraft,” Teal Group Corporation (February 2016), 2.

-
- ³¹² Eric Trappier, “Dassault Aviation Financial,” Press Release, Saint Cloud (March 8, 2017), 2.
- ³¹³ Trappier, “Dassault Aviation Financial,” 2.
- ³¹⁴ Trappier, “Dassault Aviation Financial,” 2.
- ³¹⁵ Trappier, “Dassault Aviation Results 2016,” 32.
- ³¹⁶ Trappier, “Dassault Aviation Results 2016,” 33.
- ³¹⁷ Trappier, “Dassault Aviation Financial,” 3.
- ³¹⁸ Trappier, “Dassault Aviation Financial,” 3.
- ³¹⁹ Aboulafia, “General Aviation/Utility, Dassault Aviation FALCON Series,” 9.
- ³²⁰ “Company Profile: Dassault Aviation S.A.,” 11.
- ³²¹ Annual Report 2016. 7.
- ³²² Ibid.
- ³²³ Hugo Meijer. “Post-Cold War Trends in the European Defence Industry: Implications for Transatlantic Industrial Relations.” *Journal of Contemporary European Studies* Vol. 18, No. 1, March 2010. 64-66.
- ³²⁴ Hugo Meijer. “Post-Cold War Trends in the European Defence Industry: Implications for Transatlantic Industrial Relations.” *Journal of Contemporary European Studies* Vol. 18, No. 1, March 2010. 65.
- ³²⁵ Burkard Schmitt. “From Cooperation to integration: defence and aerospace industries in Europe.” Chaillot Paper no. 40, (EU-ISS: July 2000): 102.
- ³²⁶ Jonathan Buck. “Airbus CEO Tom Enders Has a Flight Plan for Growth.” *Barron’s*. March 11, 2017.
<http://www.barrons.com/articles/airbus-ceo-tom-enders-has-a-flight-plan-for-growth-1489210588>
- ³²⁷ “Airbus CEO.” *Barron’s*.
- ³²⁸ Annual Report 2016. 24.
- ³²⁹ Annual Report 2016. 12.
- ³³⁰ Annual report 2016. 62.
- ³³¹ Ibid. 62.
- ³³² 2016 Annual Report. 67.
- ³³³ Airbus in China. <http://www.airbus.com/company/worldwide-presence/airbus-in-china/>
- ³³⁴ 2016 Annual Report. 26-28.
- ³³⁵ Benjamin Katz. “Airbus Wrestles Withwith Problem Planes as Profit Halves.” *Bloomberg*. April 27, 2017.
<https://www.bloomberg.com/news/articles/2017-04-27/airbus-profit-halves-as-production-setbacks-weigh-on-margins>
- ³³⁶ Boeing 2016 Annual and 10K Report, <http://investors.boeing.com/investors/overview/default.aspx>
- ³³⁷ Marketline Advantage, The Boeing Company, 2017
<http://advantage.marketline.com.nduezproxy.idm.oclc.org/Product?pid=3A4234D6-7800-4171-ABE5-823C05585F45&view=CompanyView>
- ³³⁸ Merchant Online, Boeing Co. NYS: BA
<http://www.mergentononline.com.nduezproxy.idm.oclc.org/companydetail.php?compnumber=1048&pagetype=synopsis>
- ³³⁹ MarketLine Advantage, The Boeing Company, 2017
- ³⁴⁰ Current Market Outlook 2016-2035, Boeing, <http://www.boeing.com/commercial/market/long-term-market/>
- ³⁴¹ Boeing 2016 Annual and 10K Report
- ³⁴² Boeing 2016 Annual and 10K Report, Page 8
- ³⁴³ Boeing 2016 Annual and 10K Report, Page 2
- ³⁴⁴ Boeing 2016 Annual and 10K Report
- ³⁴⁵ Boeing 2016 Annual and 10K Report, Page 5
- ³⁴⁶ Finnegan, Philip, Northrop Grumman Corp., Teal Group, Falls Church, VA, February 2016,1
- ³⁴⁷ Northrop Grumman Corporate Responsibility Report, GRI, July 2016, 1
- ³⁴⁸ Northrop Grumman, 2017 Proxy Statement
- ³⁴⁹ Deloitte, 2016 Global aerospace and defense sector financial performance study, July 2016, 3
- ³⁵⁰ Ibid, 20.
- ³⁵¹ Sorin Lungu Presentation to Swedish Defense University, Slide 28.
- ³⁵² Lockheed Martin, “2016 Annual Report,” Dec 2016, 3.
- ³⁵³ Grundman Advisory, “Aerospace, Defense & Government Services – Mergers & Acquisitions,” accessed on 12 Apr 17, http://grundmanadvisory.com/wp-content/uploads/2017/04/AD-MAP_2017_Grundman-Advisory.pdf
- ³⁵⁴ Lockheed Martin Website, accessed on 7 Apr 17, <http://www.lockheedmartin.com/us/100years/timeline.html>.
- ³⁵⁵ Lockheed Martin, “2016 Annual Report,” Dec 2016, 12-14.
- ³⁵⁶ Lockheed Martin, “2016 Annual Report,” Dec 2016, 4-6.

- ³⁵⁷ Loren Thompson, “Lockheed Martin Announces Sikorsky Purchase and Strategic Review of Services Portfolio,” *Forbes*, 20 Jul 15, accessed on 16 Apr 17, <https://www.forbes.com/sites/lorenthompson/2015/07/20/lockheed-martin-announces-sikorsky-purchase-and-strategic-review-of-services-portfolio/#42176cb5cca2>.
- ³⁵⁸ Lockheed Martin, “2016 Annual Report,” Dec 2016, 3, and Interview with senior Lockheed Martin personnel, 6 Apr 17.
- ³⁵⁹ Michael Porter, thoughts from Sorin Lungu Industrial Analytics slides, Lesson 12.
- ³⁶⁰ Richard Aboulaflia, “Lockheed Martin F-16 Fighting Falcon,” *The Teal Group*, Feb 16.
- ³⁶¹ Leslie Wayne, “Painting a Rosy Picture of a Costly Fighter Jet,” *New York Times*, 22 June 2007, 1.
- ³⁶² Loren Thompson, “Lockheed Martin Announces Sikorsky Purchase and Strategic Review of Services Portfolio,” *Forbes*, 20 Jul 15, accessed on 16 Apr 17, <https://www.forbes.com/sites/lorenthompson/2015/07/20/lockheed-martin-announces-sikorsky-purchase-and-strategic-review-of-services-portfolio/#42176cb5cca2>.
- ³⁶³ Richard Aboulaflia, “Lockheed Martin F-35 Joint Strike Fighter,” *The Teal Group*, Mar 16.
- ³⁶⁴ Irene Klotz, “SpaceX breaks Boeing-Lockheed monopoly on military space launches,” *Reuters*, accessed on 15 Apr 17, <http://www.reuters.com/article/us-space-spacex-launch-idUSKCN0XO2TC>.
- ³⁶⁵ European Union, Joint Research Center, accessed on 14 Apr 17, <http://iri.jrc.ec.europa.eu/scoreboard16.html#modal-one>
- ³⁶⁶ European Union, Joint Research Center
- ³⁶⁷ Northrop Grumman 2016 Annual Report, accessed on 14 Apr 17, http://www.northropgrumman.com/AboutUs/AnnualReports/Documents/pdfs/2016_noc_ar.pdf
- ³⁶⁸ Author’s perception of discussion with industry between Jan and Apr 17.
- ³⁶⁹ Lockheed Martin, “2016 Annual Report,” Dec 2016, 3.
- ³⁷⁰ Marillyn Hewson, “2017 Lockheed Martin Media Day,” 21 Mar 17.
- ³⁷¹ Marillyn Hewson, 21 Mar 17.
- ³⁷² Marillyn Hewson, 21 Mar 17.
- ³⁷³ Lockheed Martin, “2016 Annual Report,” Dec 2016, 4.
- ³⁷⁴ <http://www.nasdaq.com/symbol/lmt/ownership-summary#ixzz4f7PqFi00>
- ³⁷⁵ Author’s perception of discussion with industry between Jan and Apr 17.
- ³⁷⁶ Vanguard Lockheed Martin analysis reports
- ³⁷⁷ Mark Foulon Industrial Analytic Slides, 12.
- ³⁷⁸ Deloitte, “2017 Global aerospace and defense sector outlook: Growth prospects remain upbeat,” 2017, 20.
- ³⁷⁹ Lockheed Martin 4th Quarter 2016 Financial Results Conference Call, 24 Jan 17, chart 12.
- ³⁸⁰ Andrew Philip Hunter, “Keeping the Technological Edge, Leveraging Outside Innovation to Sustain the Department of Defense Technological Advantage,” *Center for Strategic and International Studies (CSIS)*, September 25, 2015, <https://www.csis.org/analysis/keeping-technological-edge-0>
- ³⁸¹ Supply Chain Research Insights: Aerospace Industry Trends, December 2015, <http://aviationweek.com/master-supply-chain/supply-chain-research-insights-aerospace-industry-trends>
- ³⁸² Boeing 2016 Annual and 10K Report, <http://investors.boeing.com/investors/overview/default.aspx>
- ³⁸³ Kathleen H. Hicks, Assessing the Third Offset Strategy, October 2016, <https://www.csis.org/analysis/assessing-third-offset-strategy>
- ³⁸⁴ Keeping the Technological Edge, CSIS, September 2015
- ³⁸⁵ Rory McDonald and Suresh Kotha, “Boeing 787: Manufacturing A Dream,” *Harvard Business School*, 9-615-048, Revision May 2015
- ³⁸⁶ UK MoD, <https://www.gov.uk/government/news/defence-budget-increases-for-the-first-time-in-six-years>, April 1 2016, accessed May 15, 2017.
- ³⁸⁷ Ulf Hammarstrom, *FXM - Swedish Defence and Security Export Agency: Exports and International Cooperation for our Future Defense* (Stockholm, Sweden: Swedish Defense and Security Export Agency. Also available at: <http://www.government.se/government-agencies/swedish-defence-and-security-export-agency-fxm/>
- ³⁸⁸ Marc R. DeVore, “Reinventing the Arsenal: Defense-Industrial Adaptation in Small States,” *Korean Journal of Defense Analysis* 28, no. 1 (03, 2016), 41.
- ³⁸⁹ *Company Profile: Saab AB*, (London, United Kingdom: MarketLine, 2017), 61.
- ³⁹⁰ Discussions with various government, industry, and academic players during meetings and roundtables in Sweden in April 2017 yielded serious concerns about increasing Russian provocations in the Baltic Region.
- ³⁹¹ Aerospace industry players visited and interviewed from January to May 2017 pointed to investor relations and demands for profitable performance as serious drivers to their ability to operate in the market. Satisfying investor requirements for the application of R&D and other company resources was reported to be successful only when a

significant return on investment (a.k.a. a business case) was able to be demonstrated. This was the case for all the publicly traded companies.

³⁹² Guy Anderson, Paul Burton, “Navigating the International Markets - FRANCE,” IHS JANES (December 2016), 8.

³⁹³ Jeffrey P. Bialos, “Fortresses and Icebergs - The Evolution of the Transatlantic Defense Market and the Implications for U.S. National Security Policy, Volume II,” Washington, D.C. Center for Transatlantic Relations (2009), 307.

³⁹⁴ Bialos, “Fortresses and Icebergs.”

³⁹⁵ Trappier, “Dassault Aviation Financial,” 2.

³⁹⁶ “Company Profile: Dassault Aviation S.A.,” 11-12.