SOVEREIGNTY & COLLABORATION: AFFORDABLE STRATEGIES IN TIMES OF AUSTERITY?

BY

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Sovereignty is the authority of a state to govern itself, the ability to operate free from external control. It is a complex and intangible entity that means many things to many people. In terms of military procurement, it is the ability to develop and operate equipment free from the eternal constraints of other nations. In this thesis, sovereignty is examined through the lenses of international theory, policy, and practice to determine whether it is an outdated attribute during times of austerity and if an alternative collaboration, delivers on its promise of affordability.

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The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, Royal Air Force, or Air University.

ABOUT THE AUTHOR

Squadron Leader Gareth Davies joined the RAF in 1996 after graduating from Loughborough University with a bachelor's degree in Aeronautical Engineering. After completing Initial Officer Training and Basic Flying Training he was posted to RAF Kinloss where he spent 6 years on CXX Squadron as a Nimrod MR2 Navigator. During this time he conducted operations, in addition to traditional maritime duties, in Afghanistan, the Balkans, and Iraq.

In 2005 Squadron Leader Davies was the first non-pilot in the RAF to be selected to attend the Empire Test Pilot School where he graduated as a Flight Test Engineer. A tour within the Air Warfare Centre followed where he acted as a Trials Officer predominantly supporting the purchase of the MQ-9 Reaper and the investigation of the use of tactical UAS in the maritime (Trial VIGILANT VIPER) and Counter-IED role.

In 2008, Squadron Leader Davies joined 39 Squadron as a Flight Commander operating the MQ-9 Reaper in support of operations in Afghanistan. Afterwards he completed a tour at the Ministry of Defence as the capability desk officer for Sentinel and RC-135 Rivet Joint. In 2013, he was awarded the RAF Spaatz Fellowship and subsequently completed a study period at the USAF School of Advanced Air & Space Studies at Maxwell AFB, Alabama.

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The genesis for this project came during my time as a capability desk officer in the Ministry of Defence supporting the procurement of RC-135 Rivet Joint for the RAF. Early on in my tour it became apparent that there were many differences between the Rivet Joint and the venerable Nimrod R1 that it was replacing. One of the key differences, however, was that the Rivet Joint was designed and developed in the United States. Despite the significant operational capability offered by this *new* platform, detractors and opportunists, and there were many, continually pointed to a lack of sovereignty as a key deficiency. But what did this mean? This thesis is my humble attempt to start to answer that question.

The opportunity to attend the School of Advanced Air and Space Studies has been a truly once in a lifetime experience. While this may seem a cliché to many, spending a year immersed in texts that I would previously never have read and exposure to the high quality faculty and students has been an opportunity that I will be eternally grateful for. In particular, I would like to thank Dr Everett Dolman and Dr Richard Bailey who have offered both guidance and patience during my endeavors.

Finally, it would be remiss of me not to thank my darling wife. Without her enduring humor and support, the experience of the past twelve months would not have been possible or as enjoyable as it has been. I apologize; all I can offer in return is that 'I promise it will calm down in October…'

ABSTRACT

Sovereignty is the authority of a state to govern itself, the ability to operate free from external control. It is a complex and intangible entity that means many things to many people. In terms of military procurement, it is the ability to develop and operate equipment free from the eternal constraints of other nations. In this thesis, sovereignty is examined through the lenses of international theory, policy, and practice to determine whether it is an outdated attribute during times of austerity and if an alternative, collaboration, delivers on its promise of affordability.

The works of realist and liberal economist schools of international relations mark two opposing positions regarding sovereignty and collaboration. Realists view sovereignty as an integral component of power; collaboration, on the other hand, increases dependency thereby diluting power and increasing political risk. Liberal economists present the opposite view. They believe that by combining diverse and specialist national strengths it is possible to raise the collective level of performance. However, defense procurement is not a true market economy. Fear of failure necessitates government intervention, and it this involvement that restricts the full benefits of collaboration from being realized.

Recent research reveals a rising advocacy for the liberal position, with academics viewing collaboration as a means of addressing funding shortfalls. This perspective has been mirrored by the United Kingdom defense policy shifting from a protective, mercantile approach to a more liberal exploitation of the global defense market. Despite these policy changes, the evidence presented in this thesis suggests that the retention of sovereignty remains directed by more domestic political and commercial considerations.

Does collaboration improve affordability? From the evidence presented here, the answer is a qualified yes. Collaboration certainly offers improved potential for short-term affordability but also does not guarantee it. Moreover, evidence suggests that in the long-term it is a strategy that will only bend, but not break, the ever-steepening cost-curve of military equipment procurement. For this reason, as technological advances continue to diversify national threats and opportunities, the question challenging nation-states in the future will not be whether to resist collaboration in favor of sovereignty, but rather when to collaborate and what sovereignty to invest in.

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Introduction

A horse! A horse! My kingdom for a horse!

- William Shakespeare, Richard III Act 5 Scene 4

On 22 August 1485 at the Battle of Bosworth Field, King Richard III led the last charge of knights in English history. Although their historical validity is debatable, Shakespeare's immortal words capture the essence of the moment: a king thrown from his horse and on the verge of defeat. To this day, historians and theatre audiences argue whether Richard desired the horse to flee in cowardice or to continue to fight to the bitter end; either way he needed a horse and, in his desperation, was willing to pay any price to any provider. This thesis is concerned with the procurement of military equipment and what price nations, in particular the United Kingdom, will pay to retain sovereignty.

What is sovereignty? The Oxford English Dictionary defines sovereignty as "Supreme power or authority. The authority of a state to govern itself or another state."[1] From the military equipment procurement perspective, this definition can be interpreted in many ways, which can be both ambiguous and emotive. As Robert Cox observed, "The changing face of politics means that sovereignty is a loose concept. The old legal definitions of ultimate and fully autonomous power are no longer meaningful. Sovereignty has gained meaning as an affirmation of cultural identity and lost meaning as power over the economy. It means different things to different people."[2] For example, while the Royal Air Force declares the collaborative procurement of the RC-135 Rivet Joint as "a vital component of the Nation's future ISTAR capabilities,"[3] public opinion decries the further jeopardizing of sovereign capability due to its reliance on foreign air-

[1] *Concise Oxford English Dictionary*, 11th ed (New York: Oxford University Press, 2004), 1380.
[2] Robert W. Cox, *Approaches to World Order*, Cambridge Studies in International Relations 40 (Cambridge ; New York: Cambridge University Press, 1996), 306.
[3] "First Rivet Joint Aircraft Delivered to the UK - News Stories - GOV.UK," accessed December 27, 2013, https://www.gov.uk/government/news/first-rivet-joint-aircraft-delivered-to-the-uk.

refueling tankers.[4] These paradoxical views highlight a developing tension for nations between their ability to afford cutting edge technology and their ability to use it at a time and place of national choosing. Central to this thesis are the questions: has the United Kingdom taken to favoring collaboration over sovereignty; if so, has it improved affordability; and finally, what, if any, are the non-financial costs?

To address these questions, a historical fiscal examination of British equipment procurement over the past 15 years is used. Particular focus is given to sovereign equipment procurement in order to identify underlying trends and issues for future investments. Financial data for major military equipment over the period, supported by case studies, lead to three inter-related conclusions being identified. First, from the perspective of equipment procurement, sovereignty is a complex entity; it comes at a price that can be traded in part, or in totality, through collaborative procurement strategies. In the cycle of design, manufacture and support, it is highly likely that there will be a reliance on a foreign entity; as a result, very few of the projects reviewed can claim to be wholly sovereign. Second, from academic and policy standpoints, abdication of sovereignty in preference for collaboration has gained increasing prominence as a defensive procurement strategy as a means to counter dwindling defense budgets. Finally, collaboration in equipment procurement is only a short-term defensive measure and, while financial pressures may necessitate their use, the intrinsic self-interest of states demands that sovereignty is a financial burden worth carrying for the long-term.

In Chapter 1, International Relations theories are used to highlight the direct linkage between sovereignty in equipment procurement and national power. In practice, sovereignty of equipment is exercised either through operational advantage—the ability of a nation to procure and operate—and Freedom of Action—the ability to conduct combat operations at a time and place of national choosing. Chapter 1 concludes with a review of recent academic research, which, in summary, identifies that increases in the price of military equipment, coupled with decreasing defense budgets, have caused a crisis in the approach taken to sovereignty: sovereignty is a liberty that nations can no

[4] "Embarrassment for MoD Because New £650million Spy Planes Cannot Refuel in Mid-air," *Mail Online*, accessed January 1, 2014, http://www.dailymail.co.uk/news/article-2266417/Embarrassment-MoD-new-650million-spy-Airseeker-planes-refuel-mid-air.html.

longer afford and many academics recommend a shift towards an alternative strategy, collaboration.

In Chapter 2, key policy documents that have defined the British approach to equipment procurement over the past two decades are examined. Analysis of these documents indicates that since 1991 United Kingdom policy has shifted markedly away from sovereignty towards collaboration. Central to this shift in policy is the nation's attempts to address the increasingly unaffordable nature of complex weapons technology.

In Chapter 3, data compiled from the National Audit Office (NAO) annual Major Project Reviews (MPR) for the period 1999 to 2013 is analyzed in an attempt to identify trends in the cost- and time-performance for military procurement projects. Analysis primarily focuses on underlying trends to identify both the cost of sovereignty and whether collaboration delivers on its promise of affordability. Analysis conducted in Chapter 3 shows that, in practice, sovereignty in equipment procurement is a complex concept that rarely appears in a pure form. Alternatively there are shades of sovereignty that may be broadly categorized as: sovereign, collaborative development, Commercial Off The Shelf (COTS), and pooling and sharing. Each category yields an element of sovereignty in favor of collaboration and, importantly, has affordability considerations. Trends identified in Chapter 3 include: despite an apparent shift in policy, at the procurement level very little appears to have changed in approaches to sovereignty; collaboration has the potential to improve affordability but it does not guarantee it; and finally, technological challenges are the key factor for adverse changes in cost- and time-performance for both sovereign and collaborative projects alike.

In Chapter 4, sovereign and collaborative procurement case studies are used to provide amplification on the trends identified in Chapter 3. Such amplification helps explain why sovereignty is associated with significant cost increases and why, in some cases, the reality of collaboration doesn't follow the theoretical model detailed in Chapter 1. Case studies investigated include: the procurement of Type 45 Destroyer, Eurofighter/Typhoon, Denmark's experience of procuring COTS ordnance during the Libyan campaign in 2011, and the NATO Alliance Ground Surveillance project.

In Chapter 5, consideration is given as to how the lessons of the past 15 years can be applied to future procurement activities. Future defense procurement activities will be

confronted by the twin challenges of increasing defense acquisition costs and technological advantage being eroded by the increasing availability of high-end commercial technology. Sovereignty and collaboration will play important roles in addressing both issues. To achieve this, it will be necessary for government policy to become increasingly prescriptive regarding collaboration. However, the government must first decide what *future* capabilities are important to its national security.

Two key themes run throughout this thesis: first is that the self-interest of states is the driving force in sovereignty. It is this self-interest that undermines any attempt to achieve affordability through collaboration. Second is the central importance of technology to equipment development. In conclusion, although collaboration may provide an effective means of enhancing a nation's operational advantage, it has significant limitations as a strategic tool for managing both short-term and long-term affordability challenges.

It has already been noted that sovereignty in equipment procurement is a complex issue. Modern weapon systems employing a "system of systems" approach to engineering means that tracing any dependencies on foreign support can be difficult and is open to interpretation. Using top level data as presented in the NAO MPRs, the primary sources for this thesis, it is sometimes difficult to identify which category of sovereignty an equipment program falls into. Therefore, for the purpose of analysis during this thesis, sovereign projects are defined as those that, in principle, appear to be capable of being developed and operated free from the external constraints of other nations. The author fully accepts, and expects, project specialists to draw alternative conclusions for their respective projects; such is the complexity of sovereignty.

Finally, as mentioned previously, financial data from NAO-generated MPRs form the backbone of this thesis. Although data provided covers a period of 15 years and captures the delivery performance of 58 projects totaling £90 billion of approved investment, in statistical terms this is still a relatively limited data pool specific to the United Kingdom. The projects selected by the NAO to feature in the MPR are chosen because they dominate the Ministry of Defence (MOD) equipment expenditure; accordingly they constitute a skewed, but nevertheless important sample, featuring the

most complex and expensive projects.[5] Therefore, the conclusions identified in this thesis cannot be interpreted as statistically significant and should only be used as a framework for consideration in future procurement activities.

[5] Professor David Kirkpatrick, "Lessons from the Report on MoD Major Projects," *RUSI Defence Systems*, June 2009, 102, http://www.rusi.org/downloads/assets/Acquisition_Issues_Lessons_from_the_MoD_RDS_Summer_09.pdf.

Chapter 1: Sovereignty—Theory

Theory then becomes a guide to anyone who wants to learn about war from books; it will light his way, ease his progress, train his judgment, and help him to avoid pitfalls.
- Carl Von Clausewitz, *On War*

Sovereignty is the authority of a state to govern itself, the ability to operate free from external control. In order to understand the role of sovereignty in the procurement of military equipment, it is first necessary to understand the portrayal of sovereignty within the context of international relations. The paradigms of international relations are both numerous and varied in their context, each likely to provide a different perspective of the problem. The international order is typically expressed in two ways: importance of power and importance of institutions.[1] Therefore, for the purpose of this thesis two contrasting theories, neorealism and economic liberalism, have been selected. By examining sovereignty through the perspective of these two prominent theories, it is possible to understand its relationship to national power and both the risks and benefits of the alternative strategy, collaboration.

The Realist Position

Realists assume anarchy—the absence of a centralized world authority—is the overarching constraint of world politics and power is essential to the creation and sustainment of order. Order can take the following forms: Balance of Power, where the counterbalance of opposing state powers serves as a restraint and equilibrium of power is a source of stability; and hegemony, where unrestrained preponderance of power provides stability.[2]

[1] G. John Ikenberry, *After Victory: Institutions, Strategic Restraint, and the Rebuilding of Order after Major Wars*, Princeton Studies in International History and Politics (Princeton: Princeton University Press, 2001), 10.
[2] *After Victory*, 24.

In *War and Change in Politics*, Robert Gilpin defines power as the economic, military, and technological capability of a state.[3] He argues that while "economic growth and demographic change are the most important forces underlying international political change," frequently "the triggering mechanism for change may be the major technological, military or economic changes that premise significant gains to a particular state or major losses to other states in the international system."[4] Technological and military changes manifest themselves in the ability of a nation to deliver operational advantage and superior military technology.

John Mearshimer also highlights the importance of technology to the power of the state. "Furthermore, great powers not only seek to imitate successful practices, they also prize innovation. States look for new ways to gain advantage over opponents, by developing new weapons, innovative doctrine, or clever strategy."[5] However, as Robert Pape observes, any advantage through technology will be temporal in nature because "states do not acquire new technologies simultaneously, which means that the innovator often gains significant, albeit temporary, advantages over the laggard."[6]

Realists view international politics as a zero-sum game; one nation's gain is another nation's loss. With this in mind, a realist views collaboration in the procurement of equipment as a compromise in power. As Kenneth Waltz observed, "States do not willingly place themselves in situations of increased dependence. In a self-help system, considerations of security subordinate economic gain to political interest."[7] In practice, interdependence in equipment procurement manifests itself in heightened risks in both the short and long-term. In the short-term, realist concerns include: in a world of joint supply chains, is a state's ability to operate the equipment independently of other nations reduced; do increases in the number of procuring nations correspond to reduced agility in development of equipment; how are variations in nations requirements resolved?

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[3] Robert Gilpin, *War and Change in World Politics* (Cambridge; New York: Cambridge University Press, 1981), 13.
[4] Gilpin, *War and Change in World Politics*, 55.
[5] John J Mearsheimer, *The Tragedy of Great Power Politics* (New York: Norton, 2001), 163.
[6] Mearsheimer, *The Tragedy of Great Power Politics*, 231.
[7] Kenneth N Waltz, *Theory of International Politics* (Long Grove, Ill.: Waveland Press, 2010), 107.

Furthermore, the loss of both technical and industrial support bases—one of the short-term cost benefits of collaboration—means that reverting to a sovereign option in the longer-term is made increasingly unaffordable. The validity of these concerns will be addressed in the next chapter.

Despite these risks, a realist's view on collaboration is that it is not something that should be avoided at all costs. For example, Waltz argues that "… a state is sovereign means that it will decide for itself how it will cope with its internal and external problems, including whether or not to seek assistance from others and in doing so to limits its freedom by making commitments to them."[8] Even Machiavelli, who believed "no reliance can be had on arms other than [one's] own," found room for collaboration. He advocated collaboration if it was in the self-interest of the state and also argued that any agreement would have no moral binding force.[9] In summary, realists perceive collaboration as both a necessary evil and a means of achieving an end.

The Liberal Position

If realists view collaboration with trepidation, for liberalists, such as Adam Smith, it serves as a guiding principal. Codified in *The Wealth of Nations*, Smith's seminal work served as a challenge to existing feudal and mercantile controls of the late eighteenth century. Mercantilists viewed trading with other countries as a zero-sum game whereas Smith believed wealth could be increased through specialization and trading. Smith's argument rested on three principles: the prime psychological drive of man as an economic being is self-interest; that a natural order exists in the universe, which makes all the individual strivings for self-interest add up to a social good; and the best program is to leave the economic process alone—what later became known as laissez faire, economic liberalism, or non-interventionism.[10]

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[8] Waltz, *Theory of International Politics*, 96.
[9] Niccolò Machiavelli, *The Art of War* (Wilder Publications, 2008); Terry Nardin and David Mapel, *Traditions of International Ethics* (Cambridge; New York: Cambridge University Press, 1992), 68.
[10] Adam Smith, *The Wealth of Nations* (New York: Random House Inc., 1937), viii.

For Smith, the key to success in the industrial era was through the division of labor. Using the manufacture of steel pins as an example, Smith observed that, through division of labor, ten men produced forty-eight thousand pins in a day. In contrast, Smith observed that the same ten men, individually, would have not produced twenty, perhaps not even one pin in a day.[11] Smith attributed this quantitative improvement to: increasing dexterity; saving time passing from one task to another; and the invention of machinery to complete the simplified tasks.[12] But the underlying theme to this increase in production was cooperation. Division of labor enabled each manufacturing unit to specialize but introduced dependency on other units to complete the process.

In Smith's mind, restricting cooperation to the domestic market served as restraint on the free market, something he vehemently opposed.[13] As he observed in *Wealth of Nations*, "the general industry of a country … is certainly not employed to the greatest advantage, when it is thus directed towards an object that it can buy cheaper than it can make."[14] However, although Smith advocated an international free market, he did concede that defense was an area where protection of domestic industry was acceptable.[15] A reason for the latitude offered by Smith is due to his view that "the first duty of the sovereign, that of protecting the society from the violence and invasion of other independent societies, can be performed only by means of a military force."[16]

Smith also acknowledged the sovereign's principal duty is a costly business, both in times of war and peace, with one of the principal cost drivers being technology.[17] In the late eighteenth century, Smith viewed the introduction of gunpowder as a technology capable of delivering operational advantage between nations. The advantage came at a financial cost, but it was a cost worth paying: "In modern war the great expence [*sic*] of fire-arms gives an evident advantage which can best afford that expence [*sic*]."[18]

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[11] Smith, *The Wealth of Nations*, 5.
[12] Smith, *The Wealth of Nations*, 7.
[13] *The Concise Encyclopedia of Economics* (Indianapolis, Ind: Liberty Fund, 2008), 591.
[14] Smith, *The Wealth of Nations*, 424.
[15] Smith, *The Wealth of Nations*, 429.
[16] Smith, *The Wealth of Nations*, 653.
[17] Smith, *The Wealth of Nations*, 668.
[18] Smith, *The Wealth of Nations*, 669.

David Ricardo identified further benefits of cooperation in the early nineteenth century in his opposition of the Corn Laws, tariffs designed to protect United Kingdom corn manufacturing. In his argument he formulated the idea that there can be mutual benefit from international trade. He argued that a nation should concentrate on sectors where it had a comparative advantage: the ability to produce one thing at a lower cost than it could produce another. By specializing in their comparative strengths, trading nations are better able to improve on their collective benefit than if they were to operate individually.[19] Nations would be at liberty to release limited resources thereby producing more and more profitable goods. This argument holds even if one party holds an absolute advantage over all of its trading counterparts.

The potential benefits offered by a liberal market are, however, somewhat restricted by the potentially unique characteristics of the defense market. A monopoly exists when a single seller attains "exclusive possession or control of the supply of or trade in a commodity of service."[20] The existence of a monopoly tends to lead to markets being characterized by a lack of economic competition to produce the goods or service and a lack of viable alternatives. The polar opposite of a monopoly is a monopsony. A monopsony is a "market situation in which there is only one buyer" who can interface with numerous providers and thereby dictate the market conditions.[21] Individually both monopolies and monopsonies are rare. However, as discussed in Chapter 3, in the United Kingdom defense industry they exist in tandem; thereby further skewing the market away from the theoretical model. In summary, liberalists espouse the benefits of collaboration, but also recognize the uniqueness of defense procurement may act to limit these benefits.

The Academic Position

The concept of equipment collaboration has been subject to limited academic research catalyzed on an intermittent basis by NATO conferences. In his review of the development of the International System, Aaron Cowley argued that diminishing

[19] *The Concise Encyclopedia of Economics.*
[20] *Concise Oxford English Dictionary*.
[21] *Concise Oxford English Dictionary*.

sovereignty was part of the natural evolution of the international order.[22] Cowley reasoned that the ability to recognize the value of cooperation, and employ it robustly, ranked among the most valuable traits of the human species and that human social structures evolved over time to help ensure survival and meet other needs. Nevertheless, he also noted that the benefits that motivate long-term cooperation are often undermined by the temptation of defection for short-term gains, and that "nations often select the bird in hand over two in the bush."[23] As Cowley observed, the EU may have been conceived at the Treaty of Westphalia but it took the painful experiences of the Thirty Years War, World War I and World War II to mature to its present, still incomplete, form. The message is simple; nation states are driven by self-interest and any compromise in sovereignty is likely to be a product of a significant strategic shock as opposed to any voluntary concession. Many academics believe that resource pressures imposed on defense spending may provide such a shock for the provision of military equipment. The impact of the reduction in defense spending from the perspective of procurers and manufacturers is now discussed in turn.

In his review of the European Union (EU) approach to military collaboration, Tomáš Valášek observed that, barring a few minor military expeditions, no EU government has gone into a "shooting war alone" since the United Kingdom fought Argentina in 1982.[24] He identified "pooling and sharing," closer cross-border cooperation in the form of common maintenance, training, and education, sharing of infrastructure, and the creation of joint units, as the tonic to offset decades of inadequate European defense budgets. He also stressed that European advances in collaboration have been episodic: "for each partnership many more countries have opted to go it alone, because they fear that they may not be able to deploy their shared units, or because they

[22] Lieutenant Colonel Aaron S. Cowley, "The Evolution of the International System: Surrender Sovereignty or Fight to the Death" (School of Advanced Air and Space Studies, Air University, 2011), 3.
[23] Cowley, "The Evolution of the International System: Surrender Sovereignty or Fight to the Death," 117.
[24] Tomáš Valášek and Centre for European Reform, *Surviving Austerity: The Case for a New Approach to EU Military Collaboration* (London: Centre for European Reform, 2011), 1.

worry about the costs."[25] Furthermore, savings through specialization, such as the Estonian effort to coordinate NATO's studying of cyber-threats, is largely negated by many governments desire to retain or develop a national capacity.[26]

The struggle to retain national capacity also resonated in Tomas Overhage's review of European military capabilities. In the wake of the 2010 banking crisis and the Libyan campaign in 2011, Overhage described nations being caught by a "defense interest trilemma" where security, sovereignty, and resource efficiency each receive differing emphasis as a result of overriding national, political, and strategic culture.[27] He argued that domestic pressures, such as the media, lead to a "short term, emotional, reactive definition of national interest."[28] As a result, nations like France and the United Kingdom seek to "to preserve the full range of military capabilities" while retaining the ability to "conduct combat operations at a time and place of national choosing."[29] Additionally, as each nation struggled to restructure its military, following the 2010 banking crisis, it was evident that cost savings were sought very much at a national level and did not reflect wider European coordination or cooperation.[30]

Faleg and Giovannini observed that a lack of coordination had extended to the European defense market, which they viewed as being characterized by the presence of a multitude of national industries, each with its own forms of protection and related national interests.[31] They argued, "Member states usually design procurement

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[25] Valášek and Centre for European Reform, *Surviving Austerity*, 8.
[26] Valášek and Centre for European Reform, *Surviving Austerity*, 40.
[27] Thomas Overhage, *Less Is More: Pooling and Sharing of European Military Capabilities in the Past and Present*, Thesis (Monterey, California: Naval Postgraduate School, June 2012), 19, http://calhoun.nps.edu/public/bitstream/handle/10945/7398/12Jun_Overhage.pdf?sequence=1.
[28] Overhage, *Less Is More: Pooling and Sharing of European Military Capabilities in the Past and Present*, 63.
[29] Overhage, *Less Is More: Pooling and Sharing of European Military Capabilities in the Past and Present*, 58.
[30] Overhage, *Less Is More: Pooling and Sharing of European Military Capabilities in the Past and Present*, 62.
[31] Alessandro Giovannini and Giovanni Faleg, *The EU Between Pooling & Sharing and Smart Defence: Making a Virtue of Necessity?*, CEPS Special Report (Brussels: Centre For European Policy Studies, May 2012), 11, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2065198.

specifications with the implicit purpose to contract national defence [*sic*] manufacturing industries, and maintain in this way the complete sovereign control of the national knowledge in defence [*sic*] production."[32] Faleg and Giovannini concluded that as emerging nations seek to turn their economic strength into a force projection capacity, collaboration might be essential if defense industries are to remain competitive. Their recommendations take three forms: first, expanding the collaboration shown in the aerospace sector to the land and maritime domains; second, agreeing long-term strategic priorities for collaborative groups to focus research and development; and finally, following Ricardo's theory of mutual gains through specialization leading to more efficient, cost-effective, and better integrated militaries. In reality, as Cowley suggests and as shown in Chapter 3, the temptation of nations to exploit short-term gains and their reticence to concede sovereignty often undermines such mitigations.

In summary, international relations theorists agree that sovereignty in defense procurement is a necessary component of national power, something that should be retained but not at any cost. Recent academic research on the procurement of military equipment is generally supportive of collaboration—it is perceived as a potential remedy to the paradoxical stranglehold of spiraling equipment costs and dwindling defense budgets. The cost of such a strategy, however, is the sacrifice of sovereignty. By promoting increased interdependence, nations attempt to address short-term affordability issues at the expense of long-term independence.

Chapter 2 contains a review of the United Kingdom major military procurement policy over the past fifteen years. Analysis addresses whether the United Kingdom is following the evolutionary cycle as described by Cowley and whether recent financial constraints have provided enough of a shock to trigger increased collaboration, as other academics suggest.

[32] Giovannini and Faleg, *The EU Between Pooling & Sharing and Smart Defence: Making a Virtue of Necessity?*, 13.

Chapter 2: Sovereignty—Policy

Over the past two decades, the key policy directives regarding United Kingdom equipment sovereignty and collaboration were: the 1991 National Audit Office (NAO) sponsored *Report on Collaborative Projects*; the 2005 *Defence Industrial Strategy* (*DIS*); and the 2012 *National Security Through Technology* White Paper. The performance of the MOD in executing these policies can be measured through Major Project Reviews (MPRs) that are presented to Parliament on an annual basis. The reviews detail cost- and time-performance of the largest defense projects that the department has chosen to invest in. The United Kingdom approach to sovereignty over past decades in terms of policy and practice are now described in turn.

Report On Collaborative Projects

The NAO sponsored *Report on Collaborative Projects* was published in February 1991 and examined the approach taken towards equipment collaboration based on the leading ten collaborative projects. Regarding collaboration and the then widening opportunities for purchasing from overseas, the report detailed three key findings that were to feature prominently in equipment procurement over the coming decades.

First, subject to an overall policy of obtaining maximum value for money, the report expected "most significant new equipment developments to be collaborative."[1] The NAO identified the following potential advantages offered by collaborative projects: cost savings compared to national alternatives; interoperability with allies; and in-service support savings through centralized spares holdings.[2] Disadvantages identified included: the impact of collaborative factors manifesting in the delay of project timescales; issues with the reconciliation of cost/work share with national objectives; constraints placed on the nation's freedom to withdraw; and the impact of withdrawal by other nations.[3]

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[1] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects* (Email from NAO, February 28, 1991), 1.
[2] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 13.
[3] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 13.

Simply put, the report forecast increasing tension in the role of sovereignty: operational advantage, access to cutting edge equipment and technology, would necessitate increased interdependence with other nations.

Second, after reviewing project performance during the period 1984 to 1988, the NAO concluded that a lack of common equipment requirements and timescales created difficulties for collaboration.[4] Furthermore, the report highlighted considerable differences in the collaborative expenditure of each operating environment. Whereas the air environment appeared to embrace partnership with other nations by apportioning approximately one third of its budget to collaborative projects, both land and maritime environments were more reticent—each apportioning less than five percent of their expenditure to cooperative projects. The prime reason cited for the difference in approach to collaboration was air's propensity for having "more expensive and technologically complex equipment where development costs account for a relatively high proportion of total procurement costs."[5] A conclusion that portrayed collaboration, as being perceived in 1991, as a negative strategy which both maritime and land could afford to avoid due to their relatively low project costs.

Finally, and perhaps most importantly, NAO analysis suggested that collaboration yielded higher production costs than sovereign projects.[6] The NAO acknowledged that this conclusion was somewhat unexpected as one of the key assumptions of collaboration is that it delivers reduced costs through sharing of non-recurring costs and economies of increased scale in production. The NAO highlighted numerous projects where the benefits of increased scale were undermined by disparate national strategies, such as standardization of equipment and in-service support.[7] Despite this observation, the NAO was generally supportive of collaborative projects because they expected increases in production costs to be offset by savings generated by collaborative research and

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[4] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 9.
[5] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 8.
[6] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 13.
[7] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 15.

development.[8] A view echoed in Faleg and Giovannini's report on the future of the European defense market. The NAO noted some significant limitations that national policies placed on collaboration and highlighted the difficulties that would need to be addressed if it were achieve its full potential. In essence, the NAO had observed that sovereignty was stopping the full benefits of collaboration from being realized.

Defence Industrial Strategy (*DIS*)

In 2005 the United Kingdom issued the *DIS* that identified future defense requirements and, for the first time, detailed the industrial capabilities needed to ensure equipment could be operated in a manner consistent with national choosing.[9] Sovereignty represented one of three strategic themes in the *DIS*, which identified a direct link between the through-life sovereignty of military equipment and national security. The *DIS* provided prescriptive measures to protect all phases of development—from research and development, through manufacture, to retaining test and evaluation capability—for every sovereign industrial sector. The *DIS* aimed for the United Kingdom government to work with its onshore industry to develop an affordable, competitive, and sustainable industrial base.[10]

The *DIS* was, however, not simply a protectionist measure to support all United Kingdom industry; instead it introduced the term "appropriate sovereignty" which was defined as "the appropriate degree of sovereignty over industrial skills, capacities, capabilities and technology to ensure operational independence against the range of operations that [the United Kingdom] wish to be able to conduct."[11] For example, the *DIS* rejected previous directives that the United Kingdom retain an absolute sovereign capability to build warship hulls onshore but it recognized the need to retain some capability in order to maintain a competence in warship design, integration, and

[8] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 1–13.
[9] *Defence Industrial Strategy: Defence White Paper*, December 2005, 2, http://www.official-documents.gov.uk/document/cm66/6697/6697.pdf.
[10] *Defence Industrial Strategy: Defence White Paper*, 2.
[11] *Defence Industrial Strategy: Defence White Paper*, 17.

development.[12] In essence, the *DIS* acknowledged the increased benefits of global competition but also directed governmental intervention to prevent the disappearance of indigenous capabilities required to maintain national security. The *DIS* represented a clear statement by the government regarding the limits against which it was willing to concede national sovereignty.

National Security Through Technology *White Paper*

In February 2012, the *National Security Through Technology* White Paper was issued; establishing the procurement policy for defense and security needs to meet the vision of *Future Force 2020*.[13] In replacing the *DIS* as a policy document, the White Paper represented a significant shift in government policy regarding equipment sovereignty. If sovereignty was a focal feature of *DIS*, it was conspicuous by its relative absence in the White Paper. The White Paper in effect signaled a move away from prescriptive measures to protect sovereignty. One possible cause for this shift in policy was the emphasis placed on the newly elected coalition government that debt-reduction was the national security priority. The coalition government implemented a reduction in defense spending of 12.24 percent in real terms over the period 2008 to 2015.[14]

The government acknowledged concerns about the shift in policy, but argued that "at a time of constrained budgets and unpredictability of threat" it was appropriate to clarify the "understanding of what operational advantages and freedom of action [the government] need to protect."[15] Where *DIS* directed detailed activities for each industrial sector to protect sovereignty, the White Paper simply listed a broader list of concepts that could be traded upon at risk. The United Kingdom position on the sovereignty of military equipment was now open to interpretation.

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[12] *Defence Industrial Strategy: Defence White Paper*, 70.
[13] Great Britain et al., *National Security through Technology: Technology, Equipment and Support for UK Defence and Security* (London: Stationery Office, 2010), 5.
[14] "Joint Concept Note 3/12, Future Air Space Operating Concept" (Ministry of Defence, September 2012), 1–8, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/49941/20120912jcn3_12_fasoc.pdf.
[15] Great Britain et al., *National Security through Technology*, 6.

The White Paper introduced two means of defining sovereignty: freedom of action and operational advantage. Freedom of action was defined as "the ability to determine internal and external affairs and act in the country's interests free from intervention by other states or entities, in accordance with [its] legal obligations."[16] While this definition may not have differed greatly from the views offered by theorists such as Machiavelli or Adam Smith, the White Paper did introduce a key caveat. Despite freedom of action being essential to national sovereignty, it would not be bought "at any cost."[17] Operational advantage was defined as "the ability to find and maintain an edge over potential adversaries."[18] The White Paper identified long-term investment as key to obtaining, and maintaining, operational advantage involving military equipment and technology. In a world of finite resources and rapidly evolving threats, the need for long-term investment presented the United Kingdom with a particularly challenging strategic choice: in which capability area to invest?

The White Paper listed four broad capability areas where sovereignty would be protected. First, if the capability was considered fundamental to the freedom of action of the nation, for example cryptography. Second, where a supplier might need access to classified material—an example being support to the propulsion and weapon system of the United Kingdom's national deterrent. Third, if the capability was considered essential to deliver an assured capability to respond, for example, the ability to maintain and update defensive aid suites at a sufficiently responsive tempo to support military operations. Finally, where the capability was considered key to delivering operational advantage and therefore a high confidence in performance would be required. This ultimately meant investment in personnel to maintain subject matter expertise in order to retain the United Kingdom's position as an intelligent customer.

The reduction in prominence in the White Paper for sovereignty was contrasted by a corresponding increase in emphasis on collaboration. Bilateral collaboration was advocated for offering "the best balance of advantages and disadvantages."[19] The United Kingdom also stated a commitment to wider European and NATO collaborative efforts,

[16] Great Britain et al., *National Security through Technology*, 26.
[17] Great Britain et al., *National Security through Technology*, 26.
[18] Great Britain et al., *National Security through Technology*, 26.
[19] Great Britain et al., *National Security through Technology*, 8.

in particular the NATO Smart Defense initiative that emphasized pooling and sharing to fill key capability gaps.[20] This dramatic shift in emphasis can be traced to perhaps the key theme in the White Paper, affordability.

At the time of issuing the White Paper, the United Kingdom government was confronted with the significant challenge of delivering an affordable strategy for national security. Despite having, at the time, the fourth largest defense budget in the world, the United Kingdom government still considered it insufficient means to face an increasingly capable and diverse range of threats.[21] In response, the United Kingdom promoted a more liberal approach to defense procurement: using the open competition of the global defense market to obtain "products that are proven, that are reliable, and that meet our *current* needs."[22] (Emphasis added)

The 'New Approach' to procurement directed by the White Paper, placed primacy on COTS products, while protection of sovereignty was relegated to the final consideration. From a policy standpoint the United Kingdom adopted an increasingly liberal position and, in line with the academic analysis, sought to balance the "potential benefits of taking a particular acquisition approach for a specific defence [*sic*] or security capability against the possible risks to [its] freedom of action."[23] The question remains, however, whether collaboration is the proverbial "maiden's prayer," or is it more a case of making short-term savings at the expense of long-term security? Chapter 3 compares the recent United Kingdom experience between collaborative and sovereign projects in an effort to identify if collaboration is really an affordable alternative to sovereignty.

[20] Great Britain et al., *National Security through Technology*, 32.
[21] Great Britain et al., *National Security through Technology*, 8.
[22] Great Britain et al., *National Security through Technology*, 6.
[23] Great Britain et al., *National Security through Technology*, 27.

Chapter 3: Sovereignty - Analysis

The primary source of evidence used in this thesis to determine the performance of equipment projects is the National Audit Office (NAO) annual Major Projects Review (MPR). The NAO is independent of the British Government and is responsible to Parliament, under the direction of the Comptroller and Auditor General, for the scrutiny of public spending. The Comptroller and Auditor General has statutory authority to report to Parliament on whether departments have used their resources effectively, efficiently, and with economy. Each year the Comptroller and Auditor General presents to Parliament data on the cost, time and performance of the 16 largest (by cost) defense projects in which the MOD has chosen to invest. These projects are known as post-main gate projects and the data is presented in the form of a MPR.[1]

Although the MPR is only a snapshot of the major projects, the volume of expenditure is considered by Parliament sufficient to serve as a reliable indicator of wider performance of MOD procurement. For example, the 2012 MPR accounted for £19.5 billion of equipment procurement and served as a foundational document for assuring Parliament of the MOD's ability to "balance prudent financial management with meeting the capability needs of the armed forces."[2]

In compiling the MPR, each project submits a Project Summary Sheet (PSS) detailing the performance of the project during the previous reporting period. Data included in the PSS includes: the original approval for the project, in terms of both cost and time; and the forecast for the project entering service as defined by the In-Service Date (ISD) —normally a point at which the Front Line Command accepts the equipment is capable of meeting the majority of Key User Requirements. By comparing these values it is possible to determine changes to both the cost- and time-performance for each project.

[1] Great Britain et al., *The Major Projects Report 2012: Ministry of Defence : Report* (London: Stationery Office, 2013), 1.
[2] Great Britain et al., *The Major Projects Report 2012*, 5.

Categorization

Included in the PSS is a summary of the project procurement route. For the purpose of this thesis these summaries are used to categorize the level of sovereignty attributed to the project. Analysis of the PSSs shows that equipment procurement may be categorized in four ways, which in decreasing levels of sovereignty are: sovereign procurement; collaborative development; Commercial Off The Shelf (COTS); and Pooling & Sharing. Each of these procurement categories is now summarized in turn.

Sovereign procurement enables the United Kingdom to exploit its own technology and resources to design, manufacture, and maintain equipment. In theory, these conditions allow the United Kingdom to both operate autonomous of other nation's approvals and have the technological and industrial infrastructure to develop any follow-on program. In practice, where a system of systems approach is used to deliver highly complex military weapon capability, it is very difficult to determine whether a system has some reliance on a foreign entity at a sub-component level. For example, consider the procurement of six Type 45 destroyers. The Type 45 was designed, manufactured, and operated as a sovereign asset, but its Principal Anti-Air Missile System (PAAMS) is a collaborative project with France and Italy. For the purpose of this analysis, sovereign projects are judged as those *intended* to be developed and operated free from the external constraints of other nations. In the instance of the Type 45, using this definition it is judged to be a sovereign platform despite the presence of PAAMS.

Under collaborative development the United Kingdom acts in partnership with other nations to design and manufacture equipment while maintenance costs continue to be met by each procuring nation. As reflected in the 1991 NAO review on collaboration, the sharing of the design and development processes necessitates an alignment of capability requirements between the procuring nations.[3] Any compromise in capability requirements needed to produce a consensus can be construed as a reduction in operational advantage and therefore a reduction in sovereignty. United Kingdom involvement in the Eurofighter/Typhoon program is an example of collaborative development.

[3] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 15.

COTS procurement sees the procuring nation divorce itself from the design and development phase of the project in order to decrease delivery times and increase cost efficiency. COTS procurement has been used increasingly over recent years, particularly in meeting the delivering against Urgent Operational Requirements for Iraq and Afghanistan. The United Kingdom's procurement of C-17 transport aircraft from the United States is an example of COTS procurement. The categorization of COTS includes the procurement of existing equipment that is modified, prior to entering service, in order to meet specific capability requirements. For example, the PANTHER Command and Liaison Vehicle is based on an Italian IVECO designed vehicle and subsequently upgraded to United Kingdom specification by BAE Land Systems.[4]

Pooling and Sharing is defined as when the dependency for the delivery of the capability is transferred completely to another country or organization in return for either funds or alternative capability. Elements of Pooling and Sharing are present in both collaborative development and COTS procurement—in both the design and development phases of manufacture the resources of other nations may be used. However, for the purpose of this thesis, Pooling and Sharing is defined as the provision of full military capability in lieu of financial contributions. Although no projects were listed as Pooling & Sharing in the MPR, in Chapter 4 the NATO collaborative procurement of Global Hawk is used as a mechanism to identify some of the benefits and issues surrounding Pooling & Sharing. A full list of the categorizations applied to each project is detailed in Appendix A.

Performance

In this section, consideration is given as to whether United Kingdom defense procurement has followed, in practice, the changes in policy described in Chapter 2. In order to do this, the differences between sovereign and collaborative projects are initially examined in two ways. First, the variation between forecast and actual expenditure is compared with corresponding observations made in a 1991 NAO audit on collaborative projects. Thereafter, the variation in the total number of sovereign and collaborative

[4] Great Britain et al., *Major Projects Report 2006: Report* (London: Stationery Office, 2006), 93.

projects detailed in MPRs during the period 1999 to 2013 is analyzed. By comparing these sets of data it is possible to identify a potential disconnect between the United Kingdom's policy and the procurement practice surrounding sovereignty.

Using the categorization described previously, it is possible to determine the variation in approved expenditure between sovereign and collaborative projects. Data detailing the variation in expenditure is detailed in Appendix A and summarized in Figure 1.[5] During the period 1999-2013, collaborative expenditure outweighed its sovereign counterpart by a ratio of two to one. Considering that a similar comparison, conducted by the NAO in 1991, determined this ratio was previously three to one in favor of sovereign expenditure, it would suggest that there has been a marked shift towards collaborative procurement over the past 15 years. Such a conclusion, particularly when placed in the context of increasing fiscal pressure on defense expenditure, appears supportive of academic theories that collaboration is a safe port in times of fiscal austerity. However, by increasing the granularity of analysis to consider defense procurement at the environmental levels of air, land and maritime it is possible to identify other factors at work.

Figure 1: Apportionment of Defense Expenditure—Sovereignty versus Collaboration

Source: Author's Original Work

Data detailing the distribution of expenditure by operating environment for the period 1999-2013 is detailed in Appendix B. As summarized in Figure 2, procurements

[5] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 7.

in the air domain accounted for 94 percent of all approved collaborative expenditure. In contrast only one maritime collaborative investment—the procurement of Extremely High Frequency/Super High Frequency Satellite Communication Terminals for selected submarines at an approved cost of £290 million—featured in the MPRs during the period. Similarly, in 1991 the NAO highlighted disparities in the approach taken by each operating environment towards collaboration; in 1987 air systems accounted for 95 percent of all collaborative expenditure whilst collaborative investment in sea systems was reported to be "very low."[6]

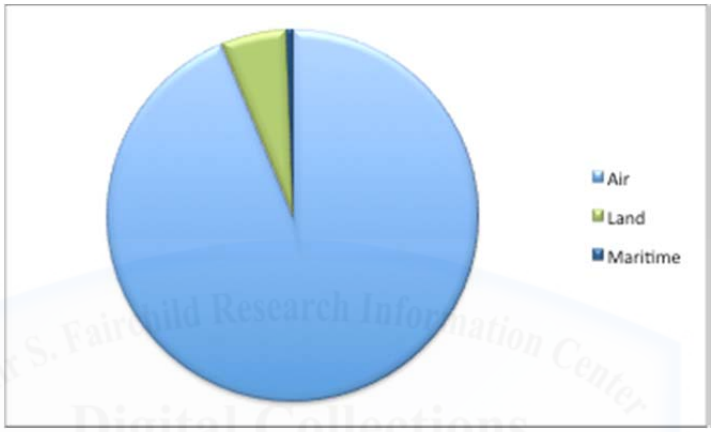

Figure 2: Collaborative Projects: Distribution of Expenditure by Operating Environment 1999-2013.

Source: Author's Original Work

Analysis by operating environment expenditure appears to counter the conclusion that a shift towards collaboration has occurred and suggests that in over two decades very little has changed for the United Kingdom in terms of the application of collaborative strategies: the air domain remains positive in its approach to collaboration while land and maritime remain reticent. To resolve this apparent conflict in conclusions a third comparison is introduced: the variation in total numbers of sovereign and collaborative projects.

Analyzing approaches to procurement through apportionment of expenditure alone may introduce a form of selection bias. Military procurement, in particular the air environment, is dominated by high unit value specialist projects. The inclusion of a few

[6] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 8.

relatively high cost projects in the data, such as Typhoon and Joint Strike Fighter—both of which occur during the period—may obscure any trends offered by more numerous, yet relatively cheaper, projects. To address this potential bias, consideration is given to the variation in numbers of collaborative and sovereign projects. Although such data was not available for the period 1984 to 1990, it is possible to trace fluctuations in procurement practices over the period 1999 to 2013. While such analysis is not supported by sufficient data to be statistically significant—the number of projects represented in each MPR is limited to approximately 16 projects—it does offer an alternative insight into trends that occur during the period.

Figure 3 illustrates the variation in the numbers of sovereign and collaborative projects featured in MPRs during the period 1999 to 2013. Also illustrated is the variation in defense expenditure over the same period; a steady increase in expenditure, attributed to commitment to campaigns in Afghanistan and Iraq, is marked by a significant decline following the *Strategic Defence and Security Review* in 2010.[7]

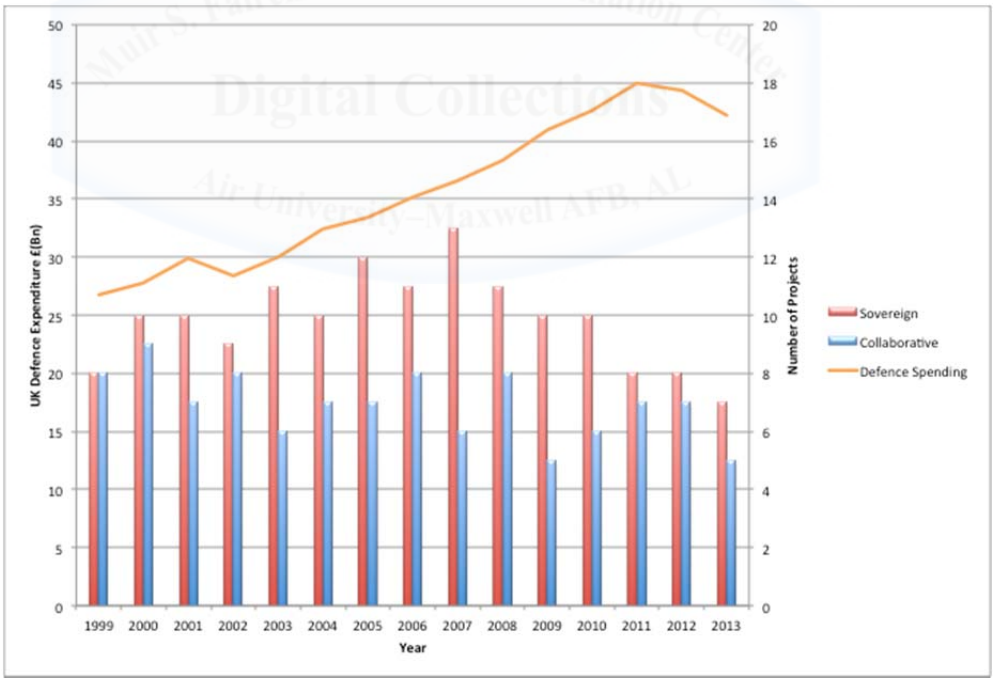

Figure 3: Variation in Defense Expenditure and Sovereign/Collaborative Projects

Source: Author's Original Work

[7] Defence spending Data "Public Spending Chart for United Kingdom 2004-2017 - Central Government Local Authorities," accessed February 25, 2014, http://www.ukpublicspending.co.uk/spending_chart_2004_2017UKb_30t#copypaste.

Figure 3 shows the number of sovereign projects featured in the MPR each year varied between seven and thirteen during the period and reached its apogee in 2007. By contrast, the number of collaborative projects varied between five and nine projects and never exceeded their sovereign counterparts. By interpreting the data across the period it is possible to conclude that the average number of sovereign and collaborative projects has remained steady at ten and seven respectively. These trends further support the assertion that very little has changed in the United Kingdom's approach to sovereignty when investing in military equipment. If this assertion is true, then it raises two further questions: why has the promise of increased collaboration not been realized; and why does the apportionment of military expenditure, as shown in Figure 1, suggest otherwise? Three possible factors can be used to explain these apparent anomalies, each are now addressed in turn.

First, it may be that collaboration opportunities have simply not arisen. As the NAO noted in 1991, sovereign equipment requirements need to align with those of other nations in order for collaboration to occur. However, as the Type 45 case study in Chapter 4 highlights, opportunities do arise but, when they occur, they are usually undermined by misaligned national capability requirements, spending limitations and work-share agreements. Second, it may be that the effect of the reduction in defense spending has yet to manifest itself into procurement trends. The average procurement period for the 2012 MPR projects was ten years.[8] Therefore, current reporting may partially reflect a legacy approach to sovereignty. In this instance, the relative shift towards collaboration shown from 2009 could be interpreted as the beginning of a long-term trend. This explanation is, however, undermined by the fact that a similar pattern of change also occurred between 2003 and 2006 and also pre-dates both the cost cuts of the 2010 SDSR and the 2011 National *Security Through Technology* White Paper. Finally, a high level of investment in air platforms—such as Typhoon, Rivet Joint, A-400M, and the Future Strategic Tanker—occurs during the period of analysis.

Taking all these factors into account, I maintain that the shifting expenditure, as shown in Figure 1, is merely a reflection of a relatively high investment in air platforms

[8] Great Britain et al., *The Major Projects Report 2012*, 4.

during the period. By extension, I conclude that, despite marked changes in policy in 2005 and 2013, very little has changed regarding the United Kingdom's approach to collaboration.

Why has there been such resistance to exploiting the perceived benefits of collaboration? One answer could be legacy institutional bias against the compromise of state sovereignty at the project level. For example, in order to realize the full cost benefits of collaboration, state infrastructure, such as shipyards, would have to be closed. In terms of sovereignty, this would be a significant step that would take generations to redress—it is worthy of note that nowhere in the data analyzed was a sovereign project initiated to replace a capability previously provided by collaboration. An alternative motive could be that the perceived cost benefits attributed to collaborative projects has simply not materialized. In 1991, the NAO hinted that the cost-benefits of collaboration might not be as clear-cut as intuition would suggest.[9] The remainder of this chapter examines these theories by comparing the cost- and time-performance of collaborative and sovereign projects.

Cost

By using data from PSS it is possible to compare the through-life variation of project costs. A detailed breakdown of project costs is presented at Appendix A. Figure 4 shows the variation of percentage project costs according to class of sovereignty as defined earlier in this chapter. The cost approvals featured in the PSSs range from £17 billion (Eurofighter/Typhoon) to £200 million (Soothsayer) therefore percentage costs, in terms of initial approval versus final delivery cost, have been used in an attempt to normalize the total cost variations. Analysis of the data shown in Figure 4 provides two differing conclusions regarding the influence that sovereignty and collaboration have on project costs.

[9] *Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects*, 19.

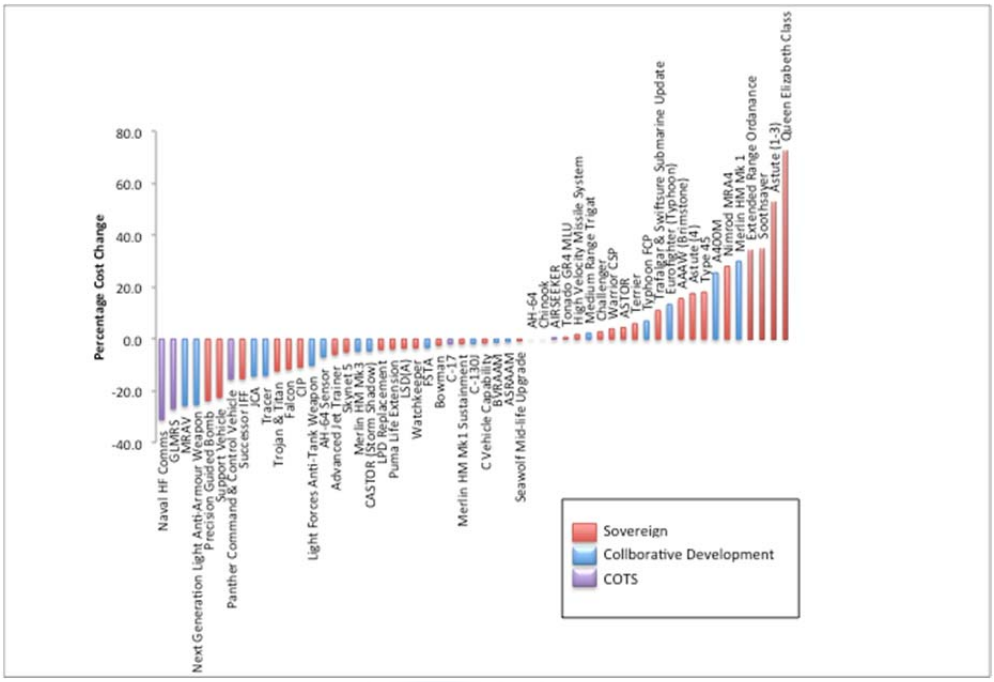

Figure 4: Cost-Performance - Percentage Cost Change

Source: Author's Original Work

First, 15 of the 31 sovereign projects analyzed experienced some form of cost-growth during their manufacture. On average, this cost growth translated into an increase in sovereign project costs of five percent over their initial approvals. Furthermore, there was a trend for sovereign projects to exhibit year on year cost growth, particularly in the lead up to a capability entering service. In some cases, particularly for larger sovereign projects, these incremental increases manifested into significant, almost unbounded, cumulative cost-growth. For instance, the procurement of the Astute class nuclear submarines and Queen Elizabeth Class aircraft carriers, are examples where project costs exceeded 50 percent of their original funding approval. Conversely, of the 16 sovereign projects that were delivered under budget, the majority produced savings of less than five percent; only the contracts to provide precision guided bombs and a land support vehicle were delivered for more than 20 percent below the expenditure initially approved. In both instances the savings were a result of MOD departmental program management as opposed to efficiencies of the projects.

Second, compared to their sovereign counterparts, the cost-performance of collaborative projects was more stable in terms of both net performance and profile. Of

the 22 collaborative projects observed, only five projects were delivered for a cost greater than their initial approval—all of which were collaborative development. Collaborative projects, on average, completed delivery of their equipment into service at a cost of five percent less than their initial approval and, as shown in Figure 4, COTS projects in particular showed a propensity for delivering on budget. Furthermore, in general, collaborative projects did not exhibit the gradual, and in some cases unbounded, increase in costs that featured significantly in the sovereign projects.

There are, however, some exceptions to the observation that collaborative projects helped bound cost growth. Indeed, there were some instances where the cost performance of collaborative development projects bore remarkable similarities to their sovereign counterparts. Of the five projects that experienced cost-growth, two projects (A400M and Merlin HM MK1) experienced cost-growth of greater than 30 percent. While data availability precludes analysis of the Merlin HM MK1 project profiles, A400M experienced a 34 percent increase in cost over a four-year period—an experience mirroring the sovereign submarine and aircraft carrier projects.

In summary, analysis of cost performance suggests two key benefits for collaborative projects. First, collaboration appears to bound total costs. Over the period there was a ten percent net difference in the cost-performance of collaborative projects over their sovereign counterparts. Second, in general, collaborative projects exhibited a fairly steady cost profile throughout the manufacturing period. The 2012 MPR noted that changing cost profiles created "turbulence and uncertainty for the Equipment Plan, reducing the [MOD's] ability to plan and manage the defence [*sic*] budget effectively."[10] Therefore, the stable cost-profiles shown by collaborative projects should support capability planning. Although these findings appear to support the academic premise that collaboration is an effective cost saving measure, the evidence presented shows this is not an absolute rule. The performance of A400M demonstrated that collaboration does not guarantee protection for a project from the spiraling cost increases observed in some sovereign projects. Furthermore, when projects are compared against their ISD, the record of collaborative projects is less favorable.

[10] Great Britain et al., *The Major Projects Report 2012*, 7.

Time

For the purpose of this thesis, ISD is the parameter used for measuring the time-performance of equipment programs. A summary of the variation between initial forecast ISD and that actually achieved is presented in Figure 5. The overriding impression of Figure 5 is the similarity in the time-performance of sovereign and collaborative projects. Both experienced significant delays in delivering equipment, with sovereign and collaborative projects suffering average delays of 22 and 17 months respectively.

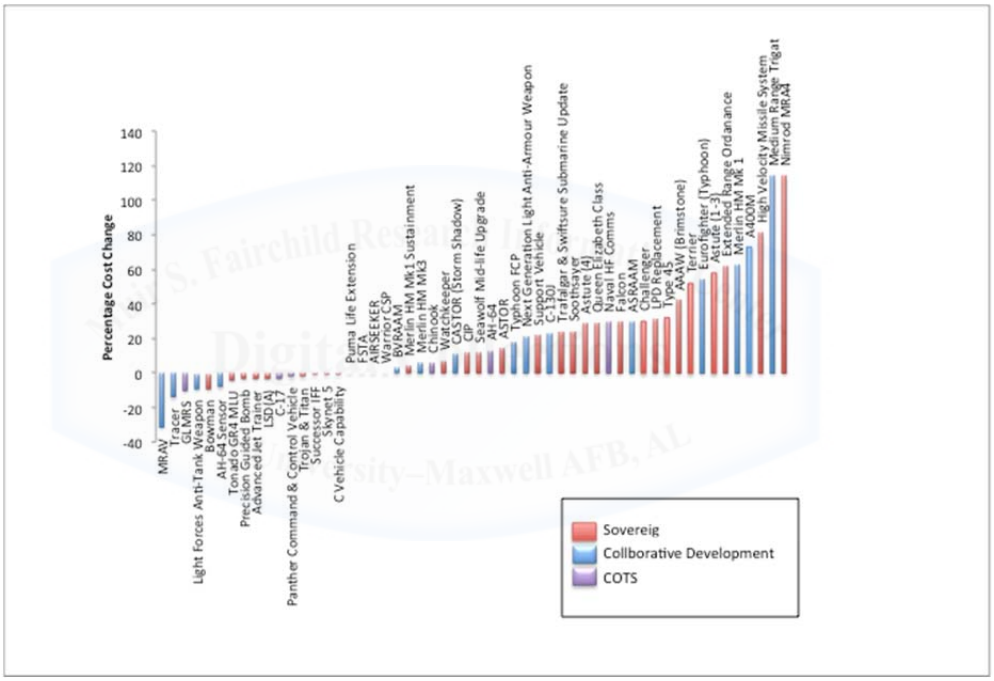

Figure 5: Time-Performance - Variation in ISD by Project

Source: Author's Original Work

Sovereign projects delivered early were outnumbered by a ratio of two to one against those delivered late. Furthermore, at least five projects—including the later cancelled Nimrod MRA4 project—experienced delays in excess of three years. In a similar comparison, collaborative projects fared little better; again late deliveries outnumbered their early counterparts, twelve to five respectively. Four projects—including the subsequently cancelled Medium Range Trigat—incurred delays in excess of three years. As with cost-performance, COTS procurements generally tended to be

delivered according to schedule. Chapter 4 will be used to provide some balance to the generally favorable view presented so far regarding COTS, by highlighting the political limitations of such an approach.

One discrepancy, in the perceived similarities in time-performance, between sovereign and collaborative projects lies in the associated costs and management of any delays. When equipment is delivered late, the MOD is generally forced to accept a capability risk associated with retaining older equipment in service in order to cover for the delay to new equipment. In some instances there are additional costs of updating existing equipment to extend its service life. A RUSI report in 2009 highlighted MOD inconsistencies in reporting secondary costs such as erosion of operational benefit, additional costs of continuing to operate predecessor equipment, and disrupted manpower and training. The report went so far as to state "some MOD project offices virtually ignore the financial and operational penalties of delay."[11] As a specific example, RUSI speculated that because Typhoon's out-of-service date was dictated by its predicted obsolescence against hostile air defense systems, its loss in operational benefit due to a four-and-a-half year delay could be as much as £4.5 billion.[12]

It would be difficult, and arguably unreasonable, to fully quantify the operational cost of delayed projects; however, it is important to recognize that the cost of any delays has to be met by the sovereign state. Although such costs apply equally to sovereign and collaborative projects, the impact is likely to mean the effect is more acute for collaborative projects where the nature of collaboration means that the needs of the group predominate. Any attempt to mitigate secondary costs through normal project management techniques, such as reducing the delay by trading capability, is dependent on an alignment of the collaborative partner's interests.

In summary, the increased delays of collaborative projects are likely to manifest in associated costs that will be met by each individual sovereign partner. In order to understand the rationale for these delays, and identify whether they serve as a delineating factor between sovereign and collaborative projects, it is instructive to investigate the causal factors listed in the PSSs.

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[11] Kirkpatrick, "Lessons from the Report on MoD Major Projects," 105.
[12] Kirkpatrick, "Lessons from the Report on MoD Major Projects," 105.

Causal Factors

The PSSs categorize the key casual factors for changes in cost- and time-performance in terms of corporate changes and project changes. Corporate changes can be either: Changed Capability Requirements, those variations in the MOD requirements flowing from operational assessment; or Budgetary Factors, changes implemented due to changed departmental budgetary priorities. Project changes are sub-categorized into: Technical Factors, variations that are due to changes in technical ability to deliver the project; Procurement Processes, changes associated with contractual processes including changes to collaborative projects; and Contracting Process, introduced from 2009 onwards, highlights changes specific to contract negotiations.[13]

Details of the causal factors affecting all MPR projects for the period 1999-2013 are provided in Appendix C. Figure 6 provides a summary of the total number of causal factors for changes in project cost- and time-performance. The influence of these causal factors on the projects is described in terms of corporate and project perspectives.

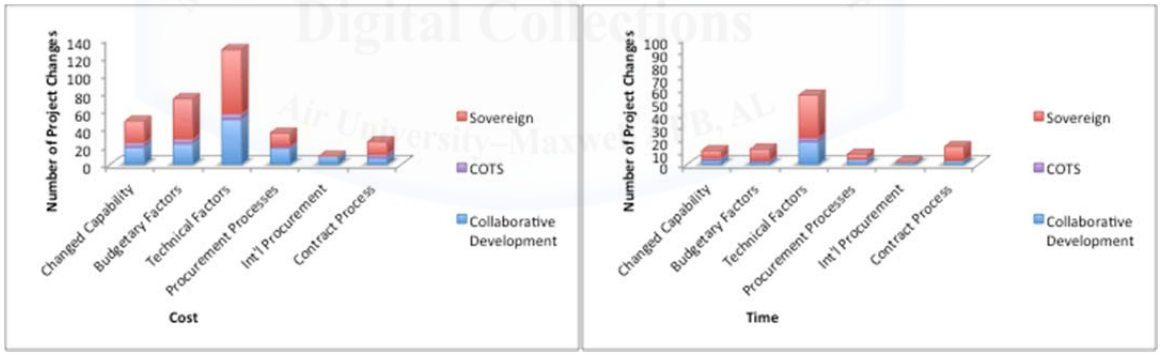

Figure 6: Causal Factors for Cost- & Time-Performance Changes (Total)

Source: Author's Original Work

From the corporate perspective, projects can be managed externally by manipulating capability requirements or budgetary inputs. Inspection of Figure 6 reveals that corporate changes were directed more towards implementing cost changes than schedule changes. During the period 1999-2013, 121 corporate changes were implemented to manage cost as opposed to only 23 to manage time. When averaged

[13] Great Britain et al., *The Major Projects Report 2012*, 12.

against the number of projects, approximately 60 percent of changes were made by collaborative projects. This finding addresses two myths surrounding collaboration: first, industry favors collaboration because the difficulties of aligning group interests effectively locks in governments to defined requirements and avoids capability creep; second, and in some ways related, collaboration restricts the role of the sovereign nation in the management of projects. Figure 6 refutes both these charges and, if anything, indicates governments may be expected to exercise more corporate control over collaborative projects than their sovereign counterparts.

Project-driven causal factors that influence cost- and time-performance changes include technical factors, procurement processes, and contract processes. Figure 6 shows that the leading causal factor, including those cited under corporate changes, is technical factors. Unlike corporate changes, technical factors influenced both cost- and time-performance with 128 and 55 changes respectively. From a cost perspective, technical factors appeared to impact collaborative development projects more than their sovereign counterparts; this potentially reflects the preponderance of air projects associated with collaborative development as identified earlier in this chapter. From a time perspective, it is difficult to differentiate between the impact of technical factors on sovereign projects and those of collaborative development—both appear to have an equally adverse effect on the performance of the project.

A secondary factor affecting project changes is procedural. Perhaps counter-intuitively, Figure 6 indicates there is very little evidence to differentiate between the programmatic changes attributed to the procedural processes of either sovereign or collaborative projects.

In summary, by examining the project performance of the recent major MOD military procurements, it has been possible to identify several conceptual themes. First, the issue of sovereignty and collaboration is more complex than it may appear at first glance. In the paradigm of military equipment procurement there exist shades of sovereignty where gradual increases in collaboration are paid for by a reduction in sovereignty. In decreasing levels of sovereignty the procurement processes identified are: sovereign procurement, collaborative development, COTS, and Pooling & Sharing.

Second, by tracing key policy documents it is possible to discern a distinct shift in the United Kingdom's approach towards sovereignty and collaboration. In the early 1990s, at the birth of the European Union, the United Kingdom appeared hesitant, almost cautious, about the opportunities offered by collaboration. By 2013, a far more liberal approach had been adopted and collaboration was seen almost as a cornerstone of policy. The reason for the change, the increasingly technologically complex nature of defense projects was making them increasingly unaffordable within a sovereign capacity. Overall, technical factors appear to be the main impediment, regardless of sovereignty status, in delivering projects within time and cost constraints.

Third, it appears that very little has changed regarding each operational environment's approach to sovereignty: air being pro-collaboration, land and maritime remaining bastions of sovereignty.

Finally, supporting the theoretical and political promise of increased affordability, economies of scale leveraged by collaboration generally provide savings but, there is no guarantee; evidence shows that collaborative projects are equally susceptible to the almost unbounded cost growth as their sovereign counterparts. In practice, from the perspective of cost- and time-performance there is very little to differentiate between sovereign and collaborative projects. Equally, fears that increased collaboration may reduce a country's sovereign input into the management of projects appear unfounded. These themes are developed, through the use of case studies, in the following chapter.

Chapter 4: The Application of Sovereignty

In this chapter, four case studies are used to highlight and develop some of the issues realized in recent sovereign and collaborative projects. The first case study considered is the United Kingdom's sovereign procurement of the Type 45 destroyer and illustrates the conflict that exists between a nation's need to deliver operational advantage, through state-of-the-art military equipment, and the practical demand to spread the associated high development costs across collaborative partnerships. The second case study considered is the European collaborative development of the Eurofighter/Typhoon fourth generation fighter. Again the project suffered significant issues with aligning interests resulting in numerous cost increases and time delays. However, when considered in the long-term, the United Kingdom gained a high-end technological capability that was beyond the national means to deliver. The next case study considers the Danish COTS procurement of precision munitions. While the United Kingdom experience of COTS procurement has been generally favorable, this case study highlights the potential implications of being entirely dependent on another state for a capability. The final case study presented is of the NATO procurement of Global Hawk unmanned air vehicles to bolster its Intelligence Surveillance and Reconnaissance (ISR) capabilities—a program that the United Kingdom has opted to contribute to via its sovereign Sentinel Wide Area Surveillance program rather than financial investment. The study highlights, in detail, the susceptibility of a collaborative project to the external influences of states pursuing national self-interest.

Type 45 Case Study—Sovereignty

In July 2000 United Kingdom Defense Ministers approved the £5 billion procurement of six, out of a planned class of 12, Type 45 destroyers as a replacement for the ageing Type 42 destroyers.[1] At approval it was estimated that the first ship would enter service in November 2007, however, ISD was not achieved until July 2010.

[1] Great Britain, *Ministry of Defence: Providing Anti-air Warfare Capability: The Type 45 Destroyer*, Report / by the Comptroller and Auditor General, HC 295 session 2008-2009 (London: Stationery Office, 2009), 4.

Since the 1980s the United Kingdom had been involved in three separate projects to replace its Type 42 destroyers. The first attempt was a collaborative project called *NATO Frigate Replacement for the 1990s* and involved the United Kingdom, the United States, Canada, France, Germany, Italy, Spain, and the Netherlands. Differing national requirements, spending limitations, and timescales made consensus impossible and the project was cancelled in 1989.[2] In 1992 another collaborative project, known as *Horizon*, was initiated between the United Kingdom, France and Italy to produce a ship and its weapon system, the Principal Anti-Air Missile System (PAAMS). Again national requirements plagued the collaboration and in 1999 the United Kingdom withdrew from *Horizon* because "costs were unacceptable … and industry could not agree a Prime Contractor Framework."[3] Although the United Kingdom withdrew from *Horizon*, they continued to collaborate with the French and Italians in developing PAAMS that would be later integrated onto the Type 45. Rather than buying a modified variant of America's multi-role DDG-51 *Arleigh Burke* Class, whose costs and performance were stable, the United Kingdom had opted to develop its own anti-air-warfare destroyer in an attempt to improve on its high-end sovereign capabilities.[4]

Withdrawal from *Horizon* meant an extension to the increasingly obsolescent Type 42 destroyers. The MOD estimated the cost of extending the Type 42s to be £195 million, the bulk of which was associated with manpower, spares, and equipment.[5] The cost of extending the Type 42s would have exceeded £400 million if the Royal Navy had not accepted a reduction in availability and readiness levels by retiring ships early: by mid-2007, Type 42 availability had fallen below 50 percent.[6] The repeated failure of collaborative efforts to deliver operational advantage resulted in fewer ships at sea, which, in turn, equated to a reduction in sovereign freedom of maneuver.

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[2] Great Britain, *Ministry of Defence*, 9.
[3] Great Britain, *Ministry of Defence*, 9.
[4] Defense Industry Daily staff googletag.display;, "DDG Type 45: Britains Shrinking Air Defense Fleet," *Defense Industry Daily*, accessed January 28, 2014, http://www.defenseindustrydaily.com/ddg-type-45-britains-shrinking-air-defense-fleet-04941/.
[5] Great Britain, *Ministry of Defence*, 10.
[6] Great Britain, *Ministry of Defence*, 11.

In 2004, the Type 45 project was experiencing significant time and cost delays and, in order to manage costs, the decision was taken to reduce the fleet size from 12 ships to six; an option to procure a further two ships was declined by the government in 2008. Although exercising this style of aggressive project management may not have been feasible in a collaborative program, it still failed to deliver all the savings envisioned. NAO analysis concluded that the sovereign construction of a Type 45, excluding development costs, was broadly in line with other types of destroyer of a similar class.[7] However, if development costs were included, the cost of the Type 45 was over £100 million more per ship than its class counterparts.[8] Because the MOD had reduced the number of ships ordered to half that originally envisioned, extensive development costs, such as the integration of PAAMS, were not spread as widely as expected.

In 2009, the House of Commons Public Accounts Committee was highly critical of the Type 45 project taking over 20 years to deliver a replacement for the Type 42. Furthermore, the Committee summarized the strategy for mitigating the ensuing capability shortfalls as one of "juggle and hope."[9] While the situation may have been born from the failings of collaboration, the Type 45 case study illustrates a key theme of this thesis; the constant friction that exists between a nation's need to deliver state-of-the-art military equipment and the institutional reticence to spread the associated high development costs across collaborative partnerships.

Eurofighter/Typhoon Case Study—Collaborative Development

When the Eurofighter entered service with the Royal Air Force it was given the name Typhoon, a decision in itself that was to raise objections with its German collaborators due to connotations of the successes of a similarly named aircraft interdicting German forces in World War II. Both the Eurofighter and Typhoon titles are used interchangeably throughout the report depending on the context.

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[7] Great Britain, *Ministry of Defence*, 19.
[8] Great Britain, *Ministry of Defence*, 19.
[9] *House of Commons Public Accounts Committee: Ministry of Defence Type 45 Destroyer* (The House of Commons, June 23, 2009), EV12, http://www.publications.parliament.uk/pa/cm200809/cmselect/cmpubacc/372/372.pdf.

When it was conceived in the late 1980s, the Eurofighter project was the poster-child of European interdependence. Collaboration between the United Kingdom, Germany, Italy, and Spain meant Eurofighter could draw upon the specialization of each nation's aerospace and defense industries. The main aim of collaboration was to reduce the cost to each partner nation in designing, producing and supporting a highly complex and technologically advanced new aircraft.[10] Certainly from the United Kingdom's perspective it was believed that the capability could not be delivered in an efficient and affordable manner without collaboration. Collaboration provided a means of increasing the operational advantage of all partner nations.

While Adam Smith advocated the invisible hand of market forces should guide the shape of such collaboration, the work-share arrangements for the Eurofighter project were driven more by political considerations than commercial or military imperatives. The result of this compromise was to impact national sovereignty in two major ways. First, the operational advantage of the project was compromised as partner nations failed to agree on long-term capability requirements. As a 2011 House of Commons Committee of Public accounts observed: "The collaborative arrangements have proved problematic. The spread of design, manufacturing and support expertise, across a number of suppliers throughout Europe has increased the cost of the aircraft overall and poses risks to the timeliness and affordability of support and upgrade activities."[11] Second, on occasion, the collaborative equipment support contract limited the freedom of maneuver of the Typhoon capability. For example, in 2008 only 70 percent of requested equipment spares had been delivered, by the required deadline, to support an operational deployment. The net result was for the remaining aircraft in the fleet to be scavenged for parts. Overall, it is estimated that shortfalls in the collaborative process used to deliver Typhoon resulted in a cost increase of approximately £2.2 billion.[12]

With these difficulties in mind, it would be easy to dismiss collaboration as failing to deliver on its promise of affordability. However, a political desire to retain a sovereign

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[10] *Report by the Comptroller General: Management of the Typhoon Project*, NAO Report, March 2, 2011, 8, http://www.nao.org.uk/wp-content/uploads/2011/03/1011755.pdf.
[11] 0/0/0000 0:00:00 AM
[12] *Report by the Comptroller General: Management of the Typhoon Project*, 24.

industrial base drove inefficiencies into the collaboration. "Typhoon contracts [were] negotiated with United Kingdom industry on a non-competitive basis under long-standing agreements which enable industry to recover agreed overhead costs."[13] Following the 2010 Strategic Defense and Security Review, the accelerated retirement and drawdown of the Harrier and Tornado fleets respectively resulted in a forecast reduction in industrial demand. Due to the long-standing arrangements, there was a risk that unless industry restructured, the cost of underutilized industry assets would be re-charged to the MOD on its remaining contracts—notably Typhoon.[14] This linkage of the Typhoon project to the long-term sustainability of the United Kingdom military aircraft industry exemplifies the distorting effect that the nexus of monopoly and monopsony can generate.

One of the key concerns of entering into collaborative projects is that interdependence with other nations will impose rigidity on the management of capabilities that is incompatible with the demands of operations. This fear was rebutted in Chapter 3, and is again here in light of Typhoon's deployment to support coalition operations in Libya in 2011. Software for the Typhoon aircraft radar and defensive aid systems was updated at speed to ensure the protection of aircraft and aircrew.[15] Furthermore, within a matter of days, the United Kingdom, on its first operational deployment of Typhoon beyond its defensive counter-air role at home and the Falklands, was able to accelerate the delivery of the aircraft's nascent air-to-ground capability.[16]

Although the Typhoon case study illustrates some of the pitfalls of collaborative development, it can also be interpreted as an exemplar of how collaboration can work. The Eurofighter project delivered a technologically advanced capability, which was beyond the means of national resources, and responsive to the needs of the nation—qualities to which any sovereign capability would aspire.

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[13] *Report by the Comptroller General: Management of the Typhoon Project*, 25.
[14] *Report by the Comptroller General: Management of the Typhoon Project*, 25.
[15] Great Britain et al., *National Security through Technology*, 24.
[16] Great Britain et al., *Operations in Libya: Ninth Report of Session 2010-12. Vol. 1, Vol. 1*, (London: Stationery Office, 2012), Ev 47.

Denmark Case Study—COTS

As described in Chapter 3, the United Kingdom's experience of procuring COTS military equipment has been relatively successful during the period of analysis. In response to Urgent Operational Requirements for Iraq and Afghanistan, COTS has proven itself as a procurement route that is both agile to a nation's requirements, assuming the desired capability exists and is available, and predictable in terms of cost- and time-performance. However, as argued previously, COTS is a short-term intervention and any savings in R&D and manufacture will ultimately serve to undermine the domestic industrial base and thereby erode any ability to deliver operational advantage in the long-term. Furthermore, as this case study shows, there is a direct correlation between dependency and increased political risk. Denmark's shortage of COTS munitions during the NATO campaign in Libya highlights another shortfall of COTS procurement: the dangers of dependency when sovereign demand exceeds foreign supply capacity.

In March 2011, Denmark on a wave of overwhelming national support deployed six F-16s to support NATO operations in Libya. In his description of Denmark's involvement in the campaign, Peter Jakobsen describes the "Danish Way of War" as being founded on the premise of collaboration and "a willingness to let its principal allies decide, where, when, and how, force will be used."[17] From a strategic perspective, Jakobsen argues, Denmark's aim "is not to win wars or even battles but to support the right cause and the right allies in order to gain goodwill, prestige, security and influence."[18] It is a policy that has a certain resonance with the *National Security Through Technology* White Paper. Over the last fifteen years, Jakobsen asserts, the pedigree of Denmark has risen to compete with that of the United Kingdom as the United States' staunchest ally. From the equipment perspective, Denmark has effectively offset the components of sovereignty, prioritizing operational advantage at the expense of freedom of maneuver.

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[17] Nanna Hvidt, Hans Mouritzen, and Danish Institute for International Studies, *Danish Foreign Policy Yearbook 2012* (Copenhagen: DIIS, 2012), 108.
[18] Hvidt, Mouritzen, and Danish Institute for International Studies, *Danish Foreign Policy Yearbook 2012*, 108.

In Libya, as in other recent conflicts in Bosnia, Kosovo, Afghanistan, and Iraq, Denmark executed its strategic role to perfection. Such was the impact of the Danish F-16s that the Joint Force Air Component Commander of Operation Odyssey Dawn, Major-General Margaret H. Woodward, dubbed them the "rock stars of the campaign."[19] Denmark's strategy, however, had a flaw; their aircraft were dependent on laser-guided munitions that were procured via a COTS process struggling to maintain tempo with the pace of operations. By June, the shortfall had become so acute that Denmark had approached the Netherlands for aid.[20] However, the intensity of the air campaign, coupled with the political emphasis for no collateral damage, led to an alliance-wide accelerated depletion of precision munitions.[21] Such was the severity of the supply shortfall that Denmark was forced to look outside its normal supplier base, a move that nearly had significant political consequences.

On 10 October 2012, the Danish Defense Force accidentally released a classified post-Libya mission report to the Danish media. Included in the report were details of how the Danish Air Force had procured munitions from Israel. The fact that the revelations were made a year after the campaign likely helped to diffuse the situation; however, they can hardly have helped Arab-Danish relations already tarnished by the publishing of cartoons of the prophet Muhammad in a Danish Newspaper in 2005. Nevertheless, the revelations were a source of embarrassment for the Danish government. Given the importance of the Arab League to the campaign, similar revelations during the conflict may not have been so limited in impact. Denmark's shortfall of laser guided bombs in Libya provides due warning that in an environment of self-interest, interdependence can be both a source of great political strength and weakness.

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[19] Hvidt, Mouritzen, and Danish Institute for International Studies, *Danish Foreign Policy Yearbook 2012*, 114.

[20] "Danish Planes in Libya Running Out of Bombs: Report," *Defense News*, accessed January 28, 2014, http://www.defensenews.com/article/20110609/DEFSECT01/106090302/Danish-Planes-Libya-Running-Out-Bombs-Report.

[21] Karen DeYoung and Greg Jaffe, "NATO Runs Short on Some Munitions in Libya," *The Washington Post*, April 16, 2011, sec. World, http://www.washingtonpost.com/world/nato-runs-short-on-some-munitions-in-libya/2011/04/15/AF3O7ElD_story.html.

NATO Alliance Ground Surveillance (AGS) Case Study - Pooling & Sharing

During the Chicago Summit, in May 2012, NATO members agreed to the acquisition of five Global Hawks and associated ground systems under the banner of the NATO AGS program. The aim of NATO AGS is to provide ground commanders with a persistent wide area surveillance capability, a noted deficiency of the alliance in the Libyan campaign.[22] Valued at $1.7 billion, NATO AGS is billed as "an affordable solution during tough economic times."[23] Unable to afford this capability individually, 14 NATO nations agreed to pool resources and share, what is considered to be, an essential capability. At face value, NATO AGS is considered an exemplar of the Pooling & Sharing opportunities offered by NATO's Smart Defense concept. However, the road to NATO AGS has been far from smooth and has yet to be fully realized.

NATO AGS originated during the 1992 Defense Planning Committee, however it was not until 2007 that consensus was achieved across the alliance for the COTS procurement of the system, including eight air platforms. Not long after, the defense budgets of member states came under increasing financial pressure. Poland was the first country to withdraw from the project in 2009 citing financial reasons. Denmark and Canada soon followed Poland's lead by withdrawing from the project in 2010 and 2011, respectively. Throughout this period the project was confronted by a dilemma of whether to increase the costs attributed to remaining members or reduce capability. When Northrop Grumman submitted revised costs in 2010, the number of Global Hawks being procured was reduced to six and later five.

One of the key attributes of NATO AGS is its improved affordability by accessing the wider Global Hawk market. A second concern for the project, outside the withdrawal of partner nations, has been the impact of the financial drawdown on wider Global Hawk sales. In May 2014, citing concerns over national certification, Germany cancelled it $1.3 billion acquisition of Euro Hawk, a Global Hawk variant.[24] In January

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[22] "NATO - Alliance Ground Surveillance (AGS)," *NATO*, accessed January 29, 2014, http://www.nato.int/cps/en/natolive/topics_48892.htm.
[23] "NATO - Alliance Ground Surveillance (AGS)," 56.
[24] "Germany Axes Euro Hawk Drone Program," *Defense News*, accessed January 29, 2014, http://www.defensenews.com/article/20130514/DEFREG01/305140015/Germany-axes-Euro-Hawk-drone-program.

2012, the USAF declared its intent to terminate the Global Hawk program in its entirety.[25] Any decrease in the size of the Global Hawk market would likely be met by corresponding increases in AGS support costs. In essence, the principal of economies of scale would be working in reverse and AGS members would be faced with footing the bill.

Both Denmark and Poland have since re-joined the project after witnessing, in Denmark's case first hand, NATO's ISR shortcomings in Libya and by reprioritizing national interests. In 2013, the United States National Defense Authorization Act stipulated that the USAF "shall maintain the operational capability of each RQ-4 Global Hawk unmanned aircraft system belonging to the Air Force or delivered to the Air Force."[26] While the battle between the USAF and Congress continues, its implications, in particular regarding cost, are sure to reverberate across AGS collaboration.

Although project data was unavailable for any Pooling and Sharing projects, analysis of NATO AGS illustrates both the strengths and weaknesses of this most extreme form of collaboration. It demonstrates that, by combining the interests of 14 nations, it is possible for nations to procure a share in technological capabilities well beyond those expected through sovereign means.

A final issue that the AGS project raises is what happens when a member nation exercises its sovereign veto? The necessity of NATO to achieve political consensus, before committing forces, may dilute capabilities that are best employed, if possible, before conflicts flare up. It is possible that such uncertainty has factored in the decision of France, the United Kingdom, and recently Germany, to offer sovereign capabilities as "contributions in kind" as opposed to financial contributions.[27] The presence of so-called contributions in kind may present a form of moral dilemma for the alliance; states may be

[25] "The Battle over Global Hawk," *Air Force Times*, accessed January 29, 2014, http://www.airforcetimes.com/article/20130715/NEWS04/307150015/The-battle-over-Global-Hawk.
[26] "The Battle over Global Hawk."
[27] "Germany, UK Offer Alternatives to Global Hawk for NATO AGS," *Aviation International News*, accessed January 29, 2014, http://www.ainonline.com/aviation-news/ain-defense-perspective/2013-06-14/germany-uk-offer-alternatives-global-hawk-nato-ags.

more inclined to invoke their veto because there is a sovereign alternative to deploying NATO Global Hawks.

In the instance of NATO AGS, collaboration provided an opportunity for several nations to gain access to capabilities beyond their national resources; however, the cost of such an advantage is the susceptibility of a collaborative project to the external influences of states pursuing national self-interest.

By reviewing the preceding series of case studies it has been possible to develop the three themes identified in Chapter 3. First, technological complexity is making it almost prohibitively expensive for most states to develop an operational advantage by sovereign means alone. Second, while collaborative projects may provide a viable means of sharing the burden of development it does not guarantee against cost and time overruns. Finally, national interests such as work share agreements and capability requirements serve to limit the full benefits of collaboration from being realized. Chapter 5 considers the implications of these themes for future procurement activities.

Chapter 5—The Future of Sovereignty

In this chapter, the level of importance that should be placed on sovereignty in future procurement activities is considered. In particular, the merit of collaboration as a strategic alternative to manage affordability is assessed. Initially, the context in which these procurement strategies will likely be employed is provided. Focus is given on two contradictory strategic drivers; economic resource and technology. Secondly, recommendations are made as to the manner in which current policy should be modified in order to maximize the benefits of both sovereignty and collaboration.

In late 2013, many analysts believed that the United Kingdom had weathered the worst of the financial storm and questioned what role the nation would play in the post-crash era. *The Economist* posited two scenarios: a fractured sovereign state or an enthusiastic global player.[1] In some ways the same scenarios apply to the United Kingdom's approach to defense procurement: retention of sovereignty or continued drift towards collaboration. One thing is certain, as "the nation [learns] to live within its means" there is unlikely to be a dramatic reversal in the painful cost-cutting measures experienced since 2010.[2] In his analysis of the 2013 Budget, RUSI Director of UK Defence Policy Studies, Professor Mark Chalmers argued, "if this Government is re-elected and sticks to its commitment to continue reductions in departmental spending in 2016/17 and 2017/18, further defence [*sic*] cuts seem inevitable."[3] The financial squeeze coupled with a continued flow of yet to be funded major equipment programs, such as the replacement for the Vanguard nuclear deterrent and introduction of the Joint Strike Fighter, means that something will have to give.

Operational advantage through technological superiority has long been considered a foundational aspect of United Kingdom defense policy. However, as shown in Chapter 3, delivering what is often highly sophisticated defense equipment within agreed costs

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[1] "Little England or Great Britain?," *The Economist*, November 9, 2013, http://www.economist.com/news/leaders/21589420-country-faces-choice-between-comfortable-isolation-and-bracing-openness-go.
[2] "Little England or Great Britain?".
[3] Malcolm Professor Chalmers, *The Squeeze Continues - UK Defence Spending and the 2013 Budget* (Royal United Services Institute, March 25, 2013), http://www.rusi.org/analysis/commentary/ref:C51506B24A254C/#.UulrjChAvrU.

and timescales is becoming an increasingly complex challenge. In their positioning paper *20YY: Preparing for War in the Robotic Age*, Work and Brimley argue that the future battle space will be dominated by technologies including: directed energy, electromagnetic rail guns, and high-powered microwave weapons; additive manufacturing and 3-D printing; synthetic biology; and technologies to enhance human performance on the battlefield.[4] The key point being, these technologies are all driven, not by the military sector but by demands and advances in the commercial sector. Rather than dictating the pace of change, the military is increasingly a passenger riding the wave of change dictated by consumer demand. As Robert Cox observed, "in the relationship between productive and military capabilities, military demand was for a long time the stimulant of new ways of organizing production … in more recent years, however, the direction of technological flow has become more ambiguous. Military innovations have become more and more dependent upon the progress of civilian technologies."[5]

The operational impact of this change in balance of investment is that civilian technology is now having an increasing impact on the battlefield. As evidence, consider John Mackinlay's assessment of the impact that the commercial communications revolution has had on insurgencies: "The surge of mass communications had for the first time given the insurgent the opportunity to mobilize an international array of migrant minorities and nations, there was no longer one or two populations involved but many and they were spread across the face of the globe."[6] The question remains what role does sovereignty play in such a challenging and uncertain security environment? In order to answer this question, the strengths and weaknesses of sovereignty and collaboration as strategic tools are examined.

In theory, sovereignty offers a nation ultimate security, both in terms of autonomous development and employment of a capability. In practice, in an environment dominated by system of systems architecture, absolute sovereignty is a rare commodity. In the past, the United Kingdom's sovereign efforts for capital projects have been largely

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[4] Robert O. Work and Shawn Brimley, *20YY: Preparing For War in the Robotic Age* (Centre for a New American Strategy, January 2014), 7, http://www.cnas.org/sites/default/files/publications-pdf/CNAS_20YY_WorkBrimley.pdf.
[5] Cox, *Approaches to World Order*, 282.
[6] John Mackinlay, *Insurgent Archipelago.* ([S.l.]: Oxford University Press, 2012), 79.

directed towards the maritime environment—the production of warships, nuclear submarines, and aircraft carriers. The evidence presented in Chapter 3 showed that whatever the operating environment, sovereign investment has come at a cost. On average, sovereign projects delivered five percent over budget and 22 months late. Indeed, some projects, like the Astute Class nuclear submarines and Queen Elizabeth aircraft carriers, have experienced cost-growth in excess of 50 percent and incurred delays of over three years. If these overruns resulted in enhanced national security then one would be right to argue that it was a wise investment. However, one need only look at the important role that Scottish shipyards are playing in the Scottish devolution debate to understand that retention of a sound military industrial base is as much about domestic politics as it is about provision of long-term military capability. When the announcement to cease shipbuilding in Portsmouth in 2014 was made, a well-placed source was reported as saying to the BBC that the government was "acutely conscious of the politics of the Clyde" ahead of the 2014 Scottish Independence referendum.[7] The concern for politicians was not so much what capability was provided, but where the capability came from, and what it meant to their domestic constituents in terms of jobs.

As summarized in Chapter 1, many academics see collaborative development as an antidote to the financial and technological pressures being confronted by sovereign projects. Project data supports these assumptions with, on average, collaborative projects out-performing their sovereign counterparts in terms of both cost- and time-performance. The evidence reviewed showed COTS projects in particular as being able to deliver within time and cost parameters. One factor that emerged from the case studies detailed in Chapter 4, and yet was undersold by the academics, was that collaboration could positively enhance a nation's technological advantage. In each case study, including, arguably, the sovereign project, foreign collaboration gave the United Kingdom access to technology that was beyond its national means.

Two fears surrounding collaboration are that it adversely affects sovereignty by reducing its freedom of action both politically and operationally. The evidence surrounding these fears draws mixed conclusions. In Chapter 3, the association that

[7] "Jobs to Go at UK Shipyards," *BBC*, November 5, 2013, sec. UK Politics, http://www.bbc.co.uk/news/uk-politics-24827403.

collaboration equates to a limitation on corporate intervention was rebutted; investigation of the causal factors that affected project changes showed that a government's ability to intervene in the management of collaborative projects is no less inhibited than for sovereign projects. Evidence did, however, support the fear that collaboration impinges a government's calculus of how and where to employ its forces, in that its decisions become increasingly linked with the self-interest of other nations. In the instance of NATO AGS this self-interest extends as far as determining the force strength of the capabilities being procured. Furthermore, analysis showed, in addition to the listed benefits, that there were three further corrosive factors affecting the collaboration in defense procurement: the detrimental effect of the misalignment of national interests; the lag between policy and implementation; and the apparent permanency of any transition from a sovereign to collaborative approach. Each of these factors is discussed below.

First, any collaborative effort is dependent on the enduring alignment of national interests and long-term political investment. As shown in each of the case studies, alignment of requirements is inherently difficult to achieve and is continually undermined by the self-interest of states. In every case, a lack of a common equipment requirement and agreed timescale amounted, in effect, to the absence of a harmonized operational requirement. Although an increase in contributing nations may reduce the costs of projects, it conversely increases the political risk. Additionally, collaboration does not always guarantee affordability. Several projects experienced the same, almost unbounded, cost-growth that plagued some sovereign projects. Moreover, as shown by the Typhoon case study, the role of domestic politics and commercial factors will undoubtedly taint any national priorities.

Second, without prescriptive measures, collaboration does not appear to be a responsive mechanism for addressing funding shortfalls. Since the formation of the European Union, the United Kingdom's approach to sovereignty has ranged from the protective prescriptive measures of the 2005 *Defence Industrial Strategy* to the more open *laissez faire* approach of the 2012 *National Security Through Technology* White Paper. Yet, throughout these political transitions, practical implementation has changed very little and continues to be assessed on an individual case-by-case basis.

Finally, transition from a sovereign to collaborative effort appears to be an irreversible strategy—of the 58 projects reported in MPRs from 1999 to 2013, none were a sovereign project initiated to replace a collaborative effort. The reason for this trend is that, in order to realize the maximum financial benefits of collaboration, it is necessary to shed domestic capabilities such as industrial base and R&D expertise. This reduced industrial and R&D support makes any subsequent sovereign effort harder to justify because of the regeneration costs.

The performance of COTS serves to illustrate the paradox facing governments when assessing whether to transition to a collaborative procurement approach. In Chapter 3, it was shown that COTS by far outperformed other modes of procurement in terms of cost- and time-performance. This raises the question why shouldn't nations adopt a COTS only approach to equipment procurement? The first issue is that the required equipment may not be on the shelf; this would result in a compromise of desired capability. Second, although COTS projects offer short-term benefits by exploiting economies of scale to increase cost-effectiveness, such benefits are likely made at the expense of longer-term sovereign capability. While investment is directed to foreign COTS projects, the life-sustaining long-term investment for sovereign assets is reduced. The net result is a withering of domestic capabilities such as design and manufacture resources, infrastructure and specialist personnel; resources that will be prohibitively expensive, both in terms of time and finance, to regenerate.

With these factors in mind, sovereignty is something that should not be conceded lightly and collaboration remains a risky strategy—nations must continually consider what happens when, not if, our friends fail us?

Policy Implications

In order to understand the policy implications of these observations, it is necessary to place them in the context of the current United Kingdom's policy regarding sovereignty, laid out in the *National Security Through Technology* White Paper. The White Paper is built on two principles: sound R&D and a commitment to delivering

operational advantage through long-term investment and access to open competition.[8] By considering these principles, in light of the observations made in this report, it is possible to develop recommendations for the future management of sovereign capabilities.

The 2012 *National Security Through Technology* White Paper identified that "technology underpins most equipment and support arrangements" and highlighted long-term R&D funding as a means of meeting "an increasingly capable and diverse range of threats."[9] Despite this commitment, commercial R&D is rapidly surpassing its military counterpart. We live in exponential times where, technology dictates the pace of evolution and, R&D fuels the engine of change. According to investigations by Scientists for Global Responsibility, the MOD spent, on average, £1.8 billion per year on research and development in the three-year period, 2008-11."[10] While this figure is a significant sum, it is only half that spent by Apple and pales into insignificance when compared to the $11.2 billion and $10.6 billion of Samsung and Microsoft respectively.[11] The only way to address this yawning research gap is through effective collaboration with partner nations. By adopting the Ricardian principles of diversification and specialization it will be possible to raise the collective benefit of military R&D to meet the demands of commercial investment.

Current policy presents sovereignty as an important quality, but not one to be retained at any cost. In essence, the policy seeks to adopt a principle of cost-effectiveness that is exercised by exposure to the free market. In some ways this policy is correct. To retain equipment sovereignty at great expense, because a nation has always had such a capability, would be folly. Furthermore, the nexus of spiraling defense costs and technological diversification necessitates a re-evaluation of the capability areas that a nation wishes to remain sovereign in. Future policy regarding sovereignty needs to

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[8] Great Britain et al., *National Security through Technology*, 8.
[9] Great Britain et al., *National Security through Technology*, 8.
[10] Stuart Parkinson, Barnaby Pace, and Philip Webber, *Offenisve Insecurity: The Role of Science and Technology In UK Security Strategies* (Scientists for Global Responsibility, September 2013), http://www.sgr.org.uk/sites/sgr.org.uk/files/SGR_Offensive_Insecurity_%20exec_sum.pdf.
[11] Julianne Pepitone, "Apple Spends Way Less Than Microsoft on R&D," *CNNMoney*, accessed January 29, 2014, http://money.cnn.com/2013/11/20/technology/mobile/apple-rd-spend/index.html.

consider the shifting technological landscape and adjust accordingly. However, in order to make these adjustments, policy should revert to prescriptive measures that dictate areas where collaboration should occur. Collaboration in defense procurement is as much about investment of political capital to develop trust and underwrite partnerships that in all likelihood will last decades. Evidence presented in this thesis suggests that without such prescriptive guidance, norms and behaviors towards sovereignty are unlikely to change rapidly. Therefore, if collaboration is to work, it is necessary for the government to provide some guidance to the invisible hand of the free market.

Both of these measures seek to promote the use of collaboration in order to mitigate resource shortfalls and help provide a level of capability beyond the national means. When viewed in this manner, collaboration should no longer be viewed as a defensive measure, a necessary product of dwindling defense budgets, but as a potential source of strength. However, this strength comes at a cost of increased dependence on other nations and as such carries the risk that someday another nation's self-interest may not align fully with your own.

Conclusion

King Richard III:
What says Lord Stanley? Will he bring his power?
Messenger:
My lord, he doth deny to come.

- William Shakespeare, Richard III Act 5 Scene 3

With these words, the balance of power at Bosworth Field shifted decisively. Lord Thomas Stanley committed his forces to the service of the House of Lancaster and Henry, Earl of Richmond. This betrayal sealed the fate of "the third sun of York." One can only imagine Richard's emotions: anger, dismay, or apprehension? Whatever the emotion, it should not have been disbelief, as throughout his turbulent history, Richard III had been a participant in a murderous game of power politics. He had witnessed his brother's rise to—and temporary removal from—the throne due to subtle shifts in the balance of power orchestrated by the scheming Earl of Warwick. Lord Thomas Stanley, a man whose family motto was *sans changer* (without changing), had achieved high office by continually ensuring his family favored both sides during any battle. Richard's world was one of self-interest, a place where alliances were a source of both strength and weakness.

After his defeat, Richard was buried in a pauper's grave. The renegade Lord Thomas Stanley was appointed Earl of Derby on 27 October 1485, and the following year confirmed as High Constable of England and High Steward of the Duchy of Lancaster. Richard's victor Henry, Earl of Richmond, subsequently crowned King Henry VII, would contrive his own alliances and, by uniting the houses of Lancaster and York through marriage, write a new chapter in English history.

The issue of sovereignty and collaboration remain as pertinent today as they were on that fateful day in 1485. In this thesis, these important issues are addressed from the perspective of the United Kingdom's approach to the procurement of military equipment. By analyzing these issues through the concepts of theory, policy, and performance, it has been possible to develop a broad understanding of the paradoxical challenges facing modern governments in the realm of equipment procurement.

Examination of the issues from both the realist and liberal economist schools of thought provide a balanced view on the benefits of sovereignty and its counterpoint, collaboration. Realists view sovereignty as an integral part of power. This view is refined by the caveat that sovereignty should not be bought at any price and that, in some instances, collaboration serves to enhance power. The price associated with such collaboration is increased political dependency. For projects with lifespans of the order of half a century, such commitment represents a significant investment of political capital.

Liberal economists present the opposite view. They believe that by combining various nation's diverse and specialist strengths it is possible to raise the collective level of performance. This position is shaped by recognition that such is the importance of defense that it does not translate into a true market economy; governments are often unwilling to allow the time, and in so doing court the possibility of failure, to let market forces do their work. It is the subsequent intervention that undermines the potential benefits from being fully realized. In essence, both realist and liberal schools of thought appear to converge on one central theme: balance is required for any approach.

In recent times, academics have tended to advocate collaboration as a means of addressing funding shortfalls. They also noted that issues such as national self-interest, domestic pressures, and isolated industrial bases have, in the past, prevented nations from fully exploiting the benefits of collaboration. Such restraints were evident throughout the fiscal review presented in this thesis and the supporting case studies. While the academics were correct in focusing on the under-exploited fiscal benefits of collaboration and the temptation of delivering capabilities beyond the national resource, they perhaps under-emphasized the chief drawback: risk and exposure to other nation's interests driven by increased interdependence.

From a policy perspective, the United Kingdom's approach to collaboration over the past twenty years has shifted from a means of opportunity to a means of necessity. The New Approach detailed in the 2012 *National Security Through Technology* White Paper emphasizes collaboration through bilateral arrangements and the procurement of COTS products. Evidence presented in this thesis suggests this may be a sound strategy in the short-term but questions whether it may, in effect, be mortgaging the nation's long-

term security. COTS, in essence, offer short-term bridges for capability shortfalls rather than sound long-term policy. By analyzing data provided by the NAO, for the period 1999 to 2013, is possible to identify three conclusions surrounding the cost- and time-performance of sovereign projects, when compared to their collaborative counterparts.

First, despite the simplistic view presented by internal national groups and some newspapers, sovereignty is a complex issue. As military systems become more technologically advanced there is an increased and perhaps necessary likelihood of collaboration occurring at some level within the system. This is before operational issues such as basing rights and over-flight are absorbed into the equation. Absolute sovereignty is a rare commodity.

Second, collaborative projects, in particular COTS projects, generally outperform sovereign projects in terms of headline costs and, to a lesser extent, time—but this does not present the whole picture. Limitations in reporting procedures mean that the financial costs associated with delays, which are, arguably, more acute for collaborative projects, are not normally considered at the departmental level. This factor suggests that the financial benefit of collaboration may not be as significant as the average ten percent cost swing reported in this thesis. Indeed, COTS aside, there is little to differentiate between sovereign and collaborative projects; both are equally susceptible to significant delays and almost unbounded cost growth. Use of case studies served to capture the non-financial costs of collaboration in particular the increased political risk and the exposure to the repercussions of other nations operating in their own self-interest.

Finally, throughout this period the air environment has appeared much more pro-collaboration than the maritime and, to a lesser extent, land environments, which have been far more reticent. Factors that may have influenced such approaches include the extended design and manufacture periods for the projects and also the associated sovereign industrial base. Such domestic factors serve to undermine the efficacy of collaboration as a means to combat insufficient financial resources.

The continued increase in the costs of military procurement, coupled with the diversification of technologies, means that nations face a strategic problem of the ends exceeding the means. As Ken Waltz observed, “To buy military equipment in the quantity and variety sufficient for military effectiveness exceeds the economic capability

of most states."[1] If collaboration is to prove an effective tool in combating these trends then two modifications to existing policy need to be considered. First, there must be a shift from the current *laissez faire* economic approach to a more prescriptive policy that details areas for collaboration, in order to overcome the environmental reticence of both the maritime and land procurement. Second, a truly free market environment, based on trust between close allies, must be established in the R&D domain. Only by accepting that the risk of sovereign failure can be mitigated by the collective benefit of collaboration can nations hope to redress the ever-increasing gap between commercial and military R&D activities.

Is collaboration an affordable strategy in times of austerity? The evidence in this paper points to a qualified yes. However, as a strategy it merely bends, but does not break, the ever-steepening equipment cost curve. For the short-term gains offered by collaboration one must consider the political costs and also what happens when opportunities for collaboration do not arise. Because of the short-term gains offered, collaboration is likely to increasingly feature on the strategic landscape. The question challenging nations in the future will not be whether to resist collaboration in favor of sovereignty, but rather *when* to collaborate and what sovereignty to invest in. In a world driven by self-interest it is important to remember that collaboration can be both a source of great strength and great weakness. Despite the rhetoric associated with increased military collaboration, and in spite of the economic pressures of the early twenty-first century, self-interest is still the prime motive of nation states. Ultimately, nation states must be honest, if only to themselves, about where they wish their self-interest to take them and then act accordingly.

[1] Waltz, *Theory of International Politics*, 183.

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Appendix A—Project Data

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
A400M	2015	Estimate				2356	2484	2619	2644	2616	2629	2632	3285	3231	3105	3268	2809
		Approval				2823	2828	2744	2744	2744	2744	2744	2744	2744	2498	2498	2238
		Difference				-242	-344	-125	-100	-128	-115	-112	541	487	607	770	571
		ISD Approval				01-Dec-09	01-Dec-09	01-Dec-09	01-Dec-09	01-Dec-09	01-Dec-09	01-Dec-09	01-Dec-09	01-Dec-09	01-Feb-09	01-Feb-09	01-Feb-09
		Forecast ISD				01-Jun-10	01-Mar-11	01-Mar-11	01-Mar-11	01-Mar-11	01-Mar-11	01-Dec-11	01-Dec-15	01-Mar-15	01-Mar-15	01-Mar-15	01-Mar-15
		Variation (Months)				6	15	15	15	15	15	24	72	63	73	73	73
		Type of Procurement				CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD
		%Cost Increase				-8.6	-12.2	-4.56	-3.64	-4.66	-4.19	-4.08	19.7	17.7	24.3	30.8	25.5
AAAW (Brimstone)	2005	Estimate	815	885	849	822	988	941		900	899						
		Approval	799	899	809	849	849	814		814	814						
		Difference	16	-14	-40	-27	139	127		86	85						
		ISD Approval	01-Dec-91	01-Sep-01	01-Sep-01	01-Sep-01	01-Sep-01	01-Sep-01		01-Sep-01	01-Sep-01						
		Forecast ISD	01-Oct-01	01-Oct-02	01-Oct-02	01-Oct-02	01-Apr-04	01-Mar-05		01-Mar-05	01-Mar-05						
		Variation (Months)	118	13	13	13	31	42		42	42						
		Type of Procurement	S	S	S	S	S	S	S	S	S						
		%Cost Increase	2	-1.56	-4.94	-3.18	16.4	15.6		10.6	10.4						
Advanced Jet Trainer	2009	Estimate										467					
		Approval										497					
		Difference										-30					
		ISD Approval										01-Feb-10					
		Forecast ISD										01-Nov-09					
		Variation (Months)										-3					
		Type of Procurement										S					
		%Cost Increase										-6					

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AIRSEEKER	2014	Estimate													659	637	
		Approval													681	633	
		Difference													22	1	
		ISD Approval													01-Oct-14	01-Oct-14	
		Forecast ISD													01-Oct-14	01-Oct-14	
		Variation (Months)													0	0	
		Type of Procurement													COTS	COTS	
		%Cost Increase													3.2	0.2	
ASRAAM	2001	Estimate		823	857												
		Approval		828	866												
		Difference		-5	-9												
		ISD Approval		01-Dec-98	01-Dec-98												
		Forecast ISD		01-Dec-00	01-Jun-01												
		Variation (Months)		24	30												
		Type of Procurement		CD	CD												
		%Cost Increase		-0.6	-1												
ASTOR	2006	Estimate	14	926	930	1013	1002	968	954								
		Approval	13	938	938	938	938	914	914								
		Difference	1	-12	-8	75	64	54	40								
		ISD Approval	01-Apr-03	01-Sep-05	01-Sep-05	01-Sep-05	01-Sep-05	01-Sep-05	01-Sep-05								
		Forecast ISD	01-Sep-05	01-Sep-05	01-Sep-05	01-Sep-05	01-Sep-05	01-Nov-05	01-Nov-06								
		Variation (Months)	29	0	0	0	0	2	14								
		Type of Procurement	S	S	S	S	S	S	S								
		%Cost Increase	7.7	-1.3	-0.9	8	6.8	5.9	4.4								

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LSD(A)	2004	Estimate				381											
		Approval				395											
		Difference				-14											
		ISD Approval				01-Oct-04	01-Oct-04										
		Forecast ISD				01-Jul-04	01-Jul-04										
		Variation (Months)				-3	-3										
		Type of Procurement				S	S										
		%Cost Increase				-3.5											
Astute (1-3)	2010	Estimate	2012	2768	2698	2707	3710	3484	3492	3656	3798	3806	3933	4041	3480	3386	3414
		Approval	2084	2726	2726	2726	2726	2578	2578	2578	2578	2578	2578	2578	2233	2233	2233
		Difference	-71	42	-28	-19	984	906	914	1078	1220	1228	1355	1463	1247	1153	1181
		ISD Approval	01-Dec-01	01-Jun-05	01-Jun-05	01-Jun-05		01-Jun-05	01-Jun-05	01-Jun-05	01-Jun-05	01-Jun-05	01-Jun-05	01-Jun-05		01-Jun-05	01-Jun-05
		Forecast ISD	01-Jun-05	01-Jun-05	01-Jun-05	01-Jun-05		01-Jan-09	01-Jan-09	01-Dec-08	01-Nov-08	01-May-09	01-Mar-10	01-Jul-10		01-Apr-10	01-Apr-10
		Variation (Months)	42	0	0	0		43	43	42	41	47	57	61		58	58
		Type of Procurement	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
		%Cost Increase	-3.4	1.5	-1	-0.7	36.1	35.1	35.5	41.8	47.3	47.6	52.6	56.7	55.8	51.6	52.9
Astute (4)	2018	Estimate											1589	1567	1404	1448	1504
		Approval											1610	1610	1279	1279	1279
		Difference											-21	-43	125	169	225
		ISD Approval														01-Aug-15	01-Aug-15
		Forecast ISD											01-Dec-16	01-Dec-16		01-Jan-18	01-Jan-18
		Variation (Months)														29	29
		Type of Procurement											S	S	S	S	S
		%Cost Increase											-1.3	-2.7	9.8	13.2	17.6

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AH-64	2001	Estimate	2704	2858	2997	3068	3168										
		Approval	2835	3015	2997	2997	2997										
		Difference	-131	-157	0	71	171										
		ISD Approval	01-Dec-97	01-Dec-99	01-Dec-99	01-Dec-99	01-Dec-99										
		Forecast ISD	01-Dec-00	01-Dec-00	01-Jan-01	01-Jan-01	01-Jan-01										
		Variation (Months)	36	12	13	13	13										
		Type of Procurement	COTS	COTS	COTS	COTS	COTS										
		%Cost Increase	-4.6	-5.2	0	2.4	5.7										
AH-64	2009	Estimate										228					
		Approval										245					
		Difference										-17					
		ISD Approval										01-Dec-09					
		Forecast ISD										01-Apr-09					
		Variation (Months)										-8					
		Type of Procurement										CD					
		%Cost Increase										-6.9					
BVRAAM	2012	Estimate				1397	1417	1355	1204	1204	1168	1279	1282	1305	1115	1122	
		Approval				1437	1437	1362	1362	1362	1362	1362	1362	1362	1136	1136	
		Difference				-40	-40	-7	-158	-158	-194	-83	-80	-57	-21	-14	
		ISD Approval				01-Aug-12	01-Aug-12	01-Aug-12	01-Aug-12	01-Aug-12	01-Aug-12	01-Aug-12	01-Aug-12	01-Aug-12	01-Aug-12	01-Aug-12	
		Forecast ISD				01-Jun-12	01-Aug-12	01-Aug-12	01-Aug-12	01-Aug-13	01-Aug-13	01-Aug-12	01-Aug-12	01-Aug-12	01-Nov-12	01-Nov-12	
		Variation (Months)				-2	0	0	0	12	12	0	0	0	3	3	
		Type of Procurement				CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	
		%Cost Increase				-2.8	-2.8	-0.5	-11.6	-11.6	-14.2	-6.1	-5.9	-4.2	-1.8	-1.2	

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Bowman	2004	Estimate					2023	1991	2007	2017	2009						
		Approval					2073	2041	2041	2014	2041						
		Difference					-50	-50	-34	-24	-32						
		ISD Approval					01-Dec-04	01-Dec-04	01-Dec-04	01-Dec-04	01-Dec-04						
		Forecast ISD					01-Mar-04	01-Mar-04	01-Mar-04	01-Mar-04	01-Mar-04						
		Variation (Months)					-9	-9	-9	-9	-9						
		Type of Procurement					S	S	S	S	S						
		%Cost Increase					-2.4	-2.4	-1.7	-1.2	-1.6						
C-130J	2000	Estimate		1042	1049												
		Approval		1060	1045												
		Difference	-14	-18	4												
		ISD Approval	01-Jul-98	01-Jul-98	01-Jul-98												
		Forecast ISD	01-May-00	01-Jun-00	01-Jun-00												
		Variation (Months)	22	23	23												
		Type of Procurement	CD	CD	CD												
		%Cost Increase		-1.7	0.4												
C-17	2001	Estimate				771	775	769									
		Approval				785	785	785									
		Difference				-14	-10	-16									
		ISD Approval				01-Dec-01	01-Dec-01	01-Dec-01									
		Forecast ISD				01-Sep-01	01-Sep-01	01-Sep-01									
		Variation (Months)				-3	-3	-3									
		Type of Procurement				COTS	COTS	COTS									
		%Cost Increase				-1.8	-1.3	-2									

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
C Vehicle Capability	2006	Estimate							710	703	703						
		Approval							714	714	714						
		Difference							-4	-11	-11						
		ISD Approval							01-Apr-06	01-Apr-06	01-Apr-06						
		Forecast ISD							01-Mar-06	01-Mar-06	01-Mar-06						
		Variation (Months)							-1	-1	-1						
		Type of Procurement							S	S	S						
		%Cost Increase							-0.6	-1.5	-1.5						
Challenger II	1998	Estimate	2378	2325													
		Approval	2312	2203													
		Difference	65	122													
		ISD Approval	01-Dec-95	01-Dec-95													
		Forecast ISD	01-Jun-98	01-Jun-98													
		Variation (Months)	30	30													
		Type of Procurement	S	S													
		%Cost Increase	2.8	5.5													
Chinook	2014	Estimate														841	
		Approval														841	
		Difference														0	
		ISD Approval														01-May-14	
		Forecast ISD														01-Nov-14	
		Variation (Months)														6	
		Type of Procurement														COTS	
		%Cost Increase														0	

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
CASTOR (Storm Shadow)	2002	Estimate	**859**	987	981	980											
		Approval	875	1027	1027	1027											
		Difference	-16	-40	-46	-47											
		ISD Approval	01-Dec-94	01-Aug-02	01-Aug-02	01-Dec-01											
		Forecast ISD	01-Dec-01	01-Dec-01	01-Dec-01	01-Nov-02											
		Variation (Months)	84	8	8	11											
		Type of Procurement	CD	CD	CD	CD											
		%Cost Increase	-1.8	-3.9	-4.5	-4.6											
CIP	2005	Estimate						340	338	338							
		Approval						379	379	379							
		Difference						-39	-41	-41							
		ISD Approval						01-Dec-04	01-Dec-04	01-Dec-04							
		Forecast ISD						01-Jul-04	01-Dec-05	01-Dec-05							
		Variation (Months)						-5	12	12							
		Type of Procurement						S	S	S							
		%Cost Increase						-10.3	-10.8	-10.8							
Eurofighter (Typhoon)	2003	Estimate	14727	18832	18869	18633	19670	19014					17526	20182	17740		
		Approval	13356	17364	17364	17364	17364	16671	16671	16671	16671	16671	16671	16671	15173		
		Difference	1371	1468	1505	1269	2306	2343					855	3511	2567		
		ISD Approval	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98	01-Dec-98		
		Forecast ISD	01-Jun-02	01-Jun-02	01-Jun-02	01-Jun-02	01-Jun-03	01-Jun-03	01-Jun-03	01-Jun-03	01-Jun-03	01-Jun-03	01-Jun-03	01-Jun-03	01-Jun-03		
		Variation (Months)	42	42	42	42	54	54	54	54	54	54	54	54	54		
		Type of Procurement	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD		
		%Cost Increase	10.3	8.5	8.7	7.3	13.3	14.1					5.1	21.1	16.9		

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Extended Range Ordinance	2003	Estimate			188												
		Approval			140												
		Difference			48												
		ISD Approval			01-May-98												
		Forecast ISD			01-Jul-03												
		Variation (Months)			62												
		Type of Procurement			S												
		%Cost Increase			34.3												
Falcon	2012	Estimate									292	291	285	270		349	
		Approval									324	324	324	324		395	
		Difference									-32	-33	-39	-54		-46	
		ISD Approval									01-Feb-11	01-Feb-11	01-Feb-11	01-Feb-11		01-Jun-10	
		Forecast ISD									01-Jun-10	01-Jun-10	01-Nov-10	01-Dec-10		01-Dec-12	
		Variation (Months)									-8	-8	-3	-2		30	
		Type of Procurement									S	S	S	S		S	
		%Cost Increase									-9.9	-10.2	-12	-16.7		-11.6	
FSTA	2014	Estimate												11917	12009	12226	11393
		Approval												12536	12307	12307	11779
		Difference												-619	-298	-41	-386
		ISD Approval												01-Nov-14	01-May-14	01-May-14	01-May-14
		Forecast ISD												01-May-14	01-May-14	01-May-14	01-May-14
		Variation (Months)												-6	0	0	0
		Type of Procurement												CD	CD	CD	CD
		%Cost Increase												-4.9	-2.4	-0.3	-3.3

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
GLMRS	2007	Estimate							263	263	91						
		Approval							360	360	360						
		Difference							-97	-97	-269						
		ISD Approval							01-Jan-08	01-Jan-08	01-Jan-08						
		Forecast ISD							01-Apr-07	01-Apr-07	01-Mar-07						
		Variation (Months)							-9	-9	-10						
		Type of Procurement							COTS	COTS	COTS						
		%Cost Increase							-26.9	-26.9	-74.7						
High Velocity Missile System	2000	Estimate		898	933	904	904										
		Approval		882	927	901	901										
		Difference		16	6	3	3										
		ISD Approval		01-Sep-97	01-Sep-97	01-Sep-97	01-Sep-97										
		Forecast ISD		01-Dec-90	01-Dec-90	01-Dec-90	01-Dec-90										
		Variation (Months)		81	81	81	81										
		Type of Procurement		S	S	S	S										
		%Cost Increase		1.8	0.6	0.3	0.3										
JCA	N/A	Estimate				2332	2327	2573	1914	1916	1858	1834	1813	2448	2112	2200	2488
		Approval				2358	2358	2236	2236	2236	2236	2236	2236	2874	2482	2566	2873
		Difference				-26	-31	337	-322	-320	-378	-402	-423	-426	-370	-366	-385
		ISD Approval				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Forecast ISD				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Variation (Months)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Type of Procurement				CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD
		%Cost Increase				-1.1	-1.3	15.1	-14.4	-14.3	-16.9	-18	-18.9	-14.8	-14.9	-14.3	-13.4

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LPD Replacement	2003	Estimate	635	810	786												
		Approval	619	819	819												
		Difference	16	-9	-33												
		ISD Approval	01-Dec-00	01-Aug-00	01-Aug-00												
		Forecast ISD	01-Mar-03	01-Mar-03	01-Mar-03												
		Variation (Months)	27	31	31												
		Type of Procurement	S	S	S												
		%Cost Increase	2.6	-1.1	-4												
Light Forces Anti-Tank Weapon	2005	Estimate						318	310	305							
		Approval						345	345	345							
		Difference						-27	-35	-40							
		ISD Approval						01-Aug-06	01-Aug-06	01-Aug-06							
		Forecast ISD						01-Nov-05	01-Nov-05	01-Jul-05							
		Variation (Months)						-9	-9	-13							
		Type of Procurement						CD	CD	CD							
		%Cost Increase						-7.8	-10.1	-11.6							
Medium Range Trigat	2005	Estimate	122	941	Cancelled 31 Mar 01												
		Approval	127	920													
		Difference	-5	21													
		ISD Approval	01-Dec-95	01-Dec-95													
		Forecast ISD	01-Jun-05	01-Jun-05													
		Variation (Months)	114	114													
		Type of Procurement	CD	CD													
		%Cost Increase	-3.9	2.3													

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Merlin HM Mk 1	1999	Estimate	5028	4081	4183												
		Approval	3867	3121	3213												
		Difference	1161	960	970												
		ISD Approval	01-Dec-93	01-Dec-93													
		Forecast ISD	01-Mar-99	01-Mar-99													
		Variation (Months)	63	63													
		Type of Procurement	CD	CD													
		%Cost Increase	30	30.8													
Merlin HM Mk 1 Sustainment	2014	Estimate									832	832	830	829	768	791	
		Approval									840	840	840	840	805	805	
		Difference									-8	-8	-10	-11	-37	-14	
		ISD Approval									01-Sep-14	01-Sep-14	01-Sep-14	01-Sep-14	01-Feb-14	01-Feb-14	
		Forecast ISD									01-Feb-14	01-Feb-14	01-Feb-14	01-Feb-14	01-Feb-14	01-Jun-14	
		Variation (Months)									-7	-7	-7	-7	0	4	
		Type of Procurement									S	S	S	S	S	S	
		%Cost Increase									-1	-1	-1.2	-1.3	-4.6	-1.7	
Merlin HM Mk 3	2000	Estimate	758	752	755												
		Approval	773	789	794												
		Difference	-15	-37	-39												
		ISD Approval	01-Dec-99	01-Dec-99	01-Dec-99												
		Forecast ISD	01-Jun-00	01-Jun-00	01-Jun-00												
		Variation (Months)	6	6	6												
		Type of Procurement	CD	CD	CD												
		%Cost Increase	-1.9	-4.7	-4.9												

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
MRAV	2008	Estimate		451	335	318	Withdrew 17 Jul 2003										
		Approval		428	428	428											
		Difference		23	-93	-110											
		ISD Approval		01-Mar-11	01-Mar-11	01-Mar-11											
		Forecast ISD		01-Aug-08	01-Aug-08	01-Aug-08											
		Variation (Months)		-31	-31	-31											
		Type of Procurement		CD	CD	CD											
		%Cost Increase		5.4	-21.7	-25.7											
Nimrod MRA4	2012	Estimate	2317	2817	2835	2838	3376	3593	3808	3516	3500	3602		3602			
		Approval	2409	2959	2982	2982	2982	2813	2813	2813	2813	2813		2813			
		Difference	-92	-142	-147	-144	394	780	995	703	687	789		789			
		ISD Approval	01-Dec-00	01-Apr-03	01-Apr-03	01-Apr-03	01-Apr-03	01-Apr-03	01-Apr-03	01-Apr-03	01-Apr-03	01-Apr-03		01-Apr-03			
		Forecast ISD	01-Mar-05	01-Dec-04	01-Dec-04	01-Nov-05	01-Mar-09	01-Sep-09	01-Sep-10	01-Sep-10	01-Sep-10	01-Dec-10		01-Oct-12			
		Variation (Months)	51	20	20	31	71	77	89	89	89	92		114			
		Type of Procurement	S	S	S	S	S	S	S	S	S	S		S			
		%Cost Increase	-3.8	-4.8	-4.9	-4.8	13.2	27.7	35.4	25	24.4	28		28			
Naval HF Comms	2012	Estimate										200					
		Approval										290					
		Difference										-90					
		ISD Approval										01-Nov-09					
		Forecast ISD										01-May-12					
		Variation (Months)										30					
		Type of Procurement										COTS					
		%Cost Increase										-31					

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Next Generation Light Anti Armour Weapon	2009	Estimate						355	356	314	318	310					
		Approval						415	415	415	415	415					
		Difference						-60	-59	-101	-97	-105					
		ISD Approval						01-Jul-07	01-Jul-07	01-Jul-07	01-Jul-07	01-Jul-07					
		Forecast ISD						01-Nov-06	01-Nov-06	01-Jul-07	01-Jul-08	01-Apr-09					
		Variation (Months)						-8	-8	0	12	21					
		Type of Procurement						CD	CD	CD	CD	CD					
		%Cost Increase						-14.5	-14.2	-24.3	-23.4	-25.3					
Panther Command and Control Vehicle	2007	Estimate								201							
		Approval								238							
		Difference								-37							
		ISD Approval								01-Nov-07							
		Forecast ISD								01-Sep-07							
		Variation (Months)								-2							
		Type of Procurement								COTS							
		%Cost Increase								-15.5							
Precision Guided Bomb	2007	Estimate							352	341	277						
		Approval							363	363	363						
		Difference							-11	-22	-86						
		ISD Approval							01-Dec-07	01-Dec-07	01-Dec-07						
		Forecast ISD							01-Sep-07	01-Sep-07	01-Sep-07						
		Variation (Months)							-3	-3	-3						
		Type of Procurement							S	S	S						
		%Cost Increase							-3.0	-6.1	-23.7						

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Puma Life Extension	2013	Estimate													326		
		Approval													339		
		Difference													-13		
		ISD Approval													01-Nov-13		
		Forecast ISD													01-Nov-13		
		Variation (Months)													0		
		Type of Procurement													S		
		%Cost Increase													-3.8		
Queen Elizabeth Class	2017	Estimate											5133	5900	5131	5348	6102
		Approval											4359	4359	3541	3541	3541
		Difference											744	1541	1590	1807	2561
		ISD Approval											01-Oct-15	01-Oct-15	01-Jul-15	01-Jul-15	01-Jul-15
		Forecast ISD											01-May-16	01-May-16	01-Oct-16	01-Jul-17	01-Dec-17
		Variation (Months)											7	7	15	24	29
		Type of Procurement											S	S	S	S	S
		%Cost Increase											17.1	35.4	44.9	51.0	72.3
Seawolf mid-life upgrade	2006	Estimate		286	284												
		Approval		288	288												
		Difference		-2	-2												
		ISD Approval		01-Dec-04	01-Dec-04												
		Forecast ISD		01-Mar-05	01-Jan-06												
		Variation (Months)		3	12												
		Type of Procurement		S	S												
		%Cost Increase		-0.7	-0.7												

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Skynet 5	2005	Estimate					2679	2775	2775								
		Approval					2920	2920	2920								
		Difference					-241	-145	-145								
		ISD Approval					01-Mar-05	01-Mar-05	01-Mar-05								
		Forecast ISD					01-Feb-05	01-Feb-05	01-Feb-05								
		Variation (Months)					-1	-1	-1								
		Type of Procurement					S	S	S								
		%Cost Increase					-8.3	-5	-5								
Soothsayer	2009	Estimate									195	202					
		Approval									150	150					
		Difference									45	52					
		ISD Approval									01-Jun-07	01-Jun-07					
		Forecast ISD									01-Feb-08	01-Jun-09					
		Variation (Months)									8	24					
		Type of Procurement									S	S					
		%Cost Increase									30	34.7					
Spearfish	1994	Estimate	1810	1348	1347												
		Approval	1628	1246	1246												
		Difference	182	102	101												
		ISD Approval	01-Dec-87	01-Dec-87	01-Dec-87												
		Forecast ISD	01-Mar-94	01-Mar-94	01-Mar-94												
		Variation (Months)	75	75	75												
		Type of Procurement	S	S	S												
		%Cost Increase	11.2	8.2	8.1												

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Successor IFF	2004	Estimate				458	471	464									
		Approval				558	558	548									
		Difference				-100	-87	-84									
		ISD Approval				01-Apr-04	01-Apr-04	01-Apr-04									
		Forecast ISD				01-Feb-04	01-Mar-04	01-Mar-04									
		Variation (Months)				-2	-1	-1									
		Type of Procurement				S	S	S									
		%Cost Increase				-17.9	-15.6	-15.3									
Support Vehicle	2008	Estimate							1362	1338	1263	1272	1272				
		Approval						1641	1641	1641	1641	1641	1641				
		Difference							-279	-303	-378	-369	-369				
		ISD Approval					01-Apr-06	01-Apr-06	01-Apr-06	01-Apr-06	01-Apr-06	01-Apr-06	01-Apr-06				
		Forecast ISD					01-Apr-07	01-Feb-08	01-Feb-08	01-Feb-08	01-Feb-08	01-Feb-08	01-Jan-08				
		Variation (Months)					12	22	22	22	22	22	22				
		Type of Procurement					S	S	S	S	S	S	S				
		%Cost Increase						0	-17	-18.5	-23	-22.5	-22.5				
Trafalgar & Swiftsure Submarine Update	2004	Estimate	705	669	687												
		Approval	673	619	619												
		Difference	32	50	68												
		ISD Approval	01-Dec-98	01-May-02	01-May-02												
		Forecast ISD	01-May-03	01-May-03	01-May-04												
		Variation (Months)	53	12	24												
		Type of Procurement	S	S	S												
		%Cost Increase	4.8	8.1	11												

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Terrier	2013	Estimate							299	296	299	313	322				
		Approval							304	304	304	304	304				
		Difference							-5	-8	-5	9	18				
		ISD Approval							01-Dec-08		01-Dec-08	01-Dec-08	01-Dec-08				
		Forecast ISD							01-Sep-08		01-Sep-09	01-Dec-11	01-Apr-13				
		Variation (Months)							-3		9	36	52				
		Type of Procurement							S	S	S	S	S				
		%Cost Increase							-1.6	-2.6	-1.6	3	5.9				
Trojan & Titan	2006	Estimate				357				336							
		Approval				407				398							
		Difference				-50				-62							
		ISD Approval				01-Dec-06				01-Dec-06							
		Forecast ISD				01-Oct-05				01-Oct-06							
		Variation (Months)				-14				-2							
		Type of Procurement				S				S							
		%Cost Increase				-12.3				-15.6							
Tornado GR4 MLU	2012	Estimate												303			
		Approval												301			
		Difference												2			
		ISD Approval												01-Mar-13			
		Forecast ISD												01-Nov-12			
		Variation (Months)												-4			
		Type of Procurement												S			
		%Cost Increase												0.7			

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Tracer	2013	Estimate	130	Cancelled													
		Approval	124														
		Difference	6														
		ISD Approval	01-Dec-04														
		Forecast ISD	08-Oct-13														
		Variation (Months)															
		Type of Procurement	CD														
		%Cost Increase	4.8														
Type 45	2010	Estimate				5279	5546		5896	6110	6464	6464	6464	6464	5664	5556	
		Approval				5837	5837	5474	5474	5475	5475	5475	5475	5475	4757	4757	
		Difference				-558	-291		421	635	989	989	989	989	907	799	
		ISD Approval				01-Nov-07	01-Nov-07	01-Nov-07	01-Nov-07	01-Nov-07	01-Nov-07	01-Nov-07	01-Nov-07	01-Nov-07	01-May-07	01-May-07	
		Forecast ISD				01-Nov-07	01-Nov-07	01-May-09	01-May-09	01-Dec-09	01-Nov-10	01-Nov-10	01-Jul-10	01-Jul-10	01-Jul-10	01-Jul-10	
		Variation (Months)				0	0	18	18	25	36	36	32	32	38	39	
		Type of Procurement				S	S	S	S	S	S	S	S	S	S	S	
		%Cost Increase				-9.6	-5	0	7.7	11.6	18.1	18.1	18.1	18.1	19.1	16.8	
Typhoon FCP	2013	Estimate										436	436	445	419	441	430
		Approval										458	458	458	410	402	402
		Difference										-22	-22	-13	9	39	28
		ISD Approval										01-Jun-12	01-Jun-12	01-Jun-12	01-Jun-12	01-Jun-12	01-Jun-12
		Forecast ISD										01-Jun-12	01-Jun-12	01-Jun-12	01-Jun-12	01-Dec-13	01-Dec-13
		Variation (Months)										0	0	0	0	18	18
		Type of Procurement										CD	CD	CD	CD	CD	CD
		%Cost Increase										-4.8	-4.8	-2.8	2.2	9.7	7.0

Project	ISD	Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Warrior CSP	2018	Estimate														1319	1371
		Approval														1319	1319
		Difference														0	52
		ISD Approval														01-Nov-18	01-Nov-18
		Forecast ISD														01-Nov-18	01-Nov-18
		Variation (Months)														0	0
		Type of Procurement														S	S
		%Cost Increase														0	3.9
Watchkeeper	2010	Estimate									901	898	895	889	839		
		Approval									920	920	920	920	847		
		Difference									-19	-22	-25	-31	-8		
		ISD Approval									01-Feb-11	01-Feb-11	01-Feb-11	01-Feb-11	01-Jan-10		
		Forecast ISD									01-Jun-10	01-Dec-10	01-Dec-10	01-Feb-11	01-Jan-10		
		Variation (Months)									-8	-2	-2	0	0		
		Type of Procurement									S	S	S	S	S		
		%Cost Increase									-2.1	-2.4	-2.7	-3.4	-0.9		
Wildcat	2014	Estimate										1911	1669	1689	1644	1663	
		Approval										1966	1966	1966	1803	1803	
		Difference										-55	-297	-277	-159	-140	
		ISD Approval										01-Aug-14	01-Aug-14	01-Aug-14	01-Jan-14	01-Jan-14	
		Forecast ISD										01-Jan-14	01-Jan-14	01-Jan-14	01-Jan-14	01-Aug-14	
		Variation (Months)										-7	-7	-7	0	7	
		Type of Procurement										S	S	S	S	S	
		%Cost Increase										-2.8	-15.1	-14.1	-8.8	-7.8	

Appendix B—Environmental Cost Data

Collaborative (Development & COTS)	Environment	Approval (£M)
A400M	Air	2498
AH-64	Air	2997
AH-64 Sensor	Air	245
AIRSEEKER	Air	633
ASRAAM	Air	866
BVRAAM	Air	1136
C-130J	Air	1045
C-17	Air	785
CASTOM (Storm Shadow)	Air	1027
Chinook	Air	841
Eurofighter (Typhoon)	Air	15173
FSTA	Air	12307
JCA	Air	2566
Merlin HM Mk 1	Air	3213
Merlin HM Mk3	Air	794
Typhoon FCP	Air	402
GLMRS	Land	360
Light Forces Anti-Tank Weapon	Land	345
Medium Range Trigat	Land	920
MRAV	Land	428
Next Generation Light Anti-Armour Weapon	Land	415
Panther Command & Control Vehicle	Land	238
Tracer	Land	124
Naval HF Comms	Maritime	290

Sovereign	Environment	Approval (£M)
AAAW (Brimstone)	Air	814
Advanced Jet Trainer	Air	497
ASTOR	Air	914
High Velocity Missile System	Air	901
Merlin HM Mk1 Sustainment	Air	805
Nimrod MRA4	Air	2813
Precision Guided Bomb	Air	363
Puma Life Extension	Air	339
Successor IFF	Air	548
Tornado GR4 MLU	Air	301
Watchkeeper	Air	847
Wildcat	Air	1803
Bowman	Land	2041
C Vehicle Capability	Land	714
Challenger	Land	2203
CIP	Land	379
Extended Range Ordanance	Land	140
Falcon	Land	395
Soothsayer	Land	150
Support Vehicle	Land	1641
Terrier	Land	304
Trojan & Titan	Land	398
Warrior CSP	Land	1319
Astute (1-3)	Maritime	2233
Astute (4)	Maritime	1279
LPD Replacement	Maritime	819
LSD(A)	Maritime	395
Queen Elizabeth Class	Maritime	3541
Seawolf Mid-life Upgrade	Maritime	288
Spearfish	Maritime	1246
Trafalgar & Swiftsure Submarine Update	Maritime	619
Type 45	Maritime	4757
Skynet	Space	2920

Appendix C—Causal Factor Data

Sovereign	Cost						Time					
	Corporate Changes		Project Changes				Corporate Changes		Project Changes			
	Changed Capability Requirements	Budgetary Factors	Technical Factors	Procurement Processes	Int'l Procurement	Contract Process	Changed Capability Requirements	Budgetary Factors	Technical Factors	Procurement Processes	Int'l Procurement	Contract Process
AAAW (Brimstone)	1	1	2	0	0	0	1	0	1	0	0	1
Advanced Jet Trainer	0	0	2	0	0	1	0	0	1	0	0	0
ASTOR	1	0	2	0	0	1	0	0	3	0	0	0
LSD(A)	0	0	0	0	0	0	0	0	0	0	0	0
Astute (1-3)	1	3	10	1	0	0	0	0	4	0	0	0
Astute (4)	0	3	8	0	0	0	0	2	0	0	0	0
Bowman	2	1	1	1	0	2	0	0	0	0	0	0
C Vehicle Capability	0	0	0	0	0	1	1	0	1	0	0	1
Challenger	1	1	0	0	0	1	0	0	1	0	0	0
Extended Range Ordanance	0	1	1	0	0	1	0	1	1	0	0	1
Falcon	2	2	2	1	0	0	1	0	5	0	0	0
CIP	0	1	4	0	0	0	0	0	3	0	0	0
High Velocity Missile System	1	1	1	0	0	1	0	1	1	0	0	1
LPD Replacement	1	1	1	1	0	0	0	0	1	1	0	1
Merlin HM Mk1 Sustainment	0	0	3	1	0	0	0	0	0	0	0	0
Nimrod MRA4	1	1	3	0	0	1	0	1	1	0	0	0
Precision Guided Bomb	1	1	1	3	0	0	0	0	0	0	0	1
Puma Life Extension	1	0	0	0	0	0	0	0	0	0	0	0
Queen Elizabeth Class	0	7	19	2	0	0	0	3	2	0	0	0
Skynet 5	0	0	0	0	0	1	0	0	0	0	0	0
Soothsayer	0	1	1	0	0	0	0	0	3	0	0	0

Successor IFF	1	0	1	1	0	1	0	0	1	0	0	1
Support Vehicle	1	1	1	0	0	0	0	1	1	0	0	1
Trafalgar & Swiftsure Submarine Update	1	0	1	0	0	0	0	0	0	0	0	1
Terrier	2	0	1	2	0	0	2	0	1	0	0	0
Trojan & Titan	2	0	1	0	0	2	1	0	0	0	0	2
Type 45	0	7	5	2	0	1	0	0	2	1	0	0
Warrior CSP	2	0	1	0	0	0	0	0	0	0	0	0
Wildcat	2	12	0	0	0	0	0	0	1	2	0	0

COTS	**Cost**						**Time**					
	Corporate Changes		**Project Changes**				**Corporate Changes**		**Project Changes**			
	Changed Capability Requirements	Budgetary Factors	Technical Factors	Procurement Processes	Int'l Procurement	Contract Process	Changed Capability Requirements	Budgetary Factors	Technical Factors	Procurement Processes	Int'l Procurement	Contract Process
AIRSEEKER	0	0	0	0	0	0	0	0	0	0	0	0
AH-64	1	1	0	1	0	1	1	1	1	0	0	0
C-17	1	0	0	1	0	1	0	0	0	0	0	0
Chinook	0	0	5	0	0	0	0	0	0	0	0	0
GLMRS	2	3	0	0	0	1	0	0	0	0	0	0
Naval HF Comms	1	0	1	0	0	1	0	0	2	0	0	0
Panther Command & Control Vehicle	0	1	0	0	0	0	1	0	0	0	0	0

Collaborative Development	Cost						Time					
	Corporate Changes		Project Changes				Corporate Changes	Project Changes				
	Changed Capability Requirements	Budgetary Factors	Technical Factors	Procurement Processes	Int'l Procurement	Contract Process	Changed Capability Requirements	Budgetary Factors	Technical Factors	Procurement Processes	Int'l Procurement	Contract Process
A400M	5	1	15	6	4	0	0	0	5	1	1	0
ASRAAM	1	0	1	0	0	1	1	0	1	0	0	0
AH-64 Sensor	0	0	1	0	0	1	0	0	1	0	0	1
BVRAAM	2	2	3	3	5	0	0	0	0	1	0	0
CASTOM (Storm Shadow)	1	1	1	0	0	0	1	0	1	0	0	1
Eurofighter (Typhoon)	2	5	9	4	0	0	0	0	1	0	1	0
FSTA	3	5	7	1	0	0	0	0	0	0	0	0
C-130J	1	0	1	0	0	1	0	0	1	0	0	0
Light Forces Anti-Tank Weapon	0	1	2	0	0	0	0	0	0	1	0	0
Medium Range Trigat	1	1	0	1	0	0	0	1	1	1	0	0
Merlin HM Mk 1	1	1	1	0	0	1	0	1	1	0	0	1
Merlin HM Mk3	1	1	1	0	0	1	0	0	1	0	0	0
MRAV	1	1	1	1	0	1	0	0	0	0	0	0
Next Generation Light Anti-Armour Weapon	0	3	1	2	0	1	1	0	3	0	0	0
Typhoon FCP	0	1	6	0	0	0	0	0	2	0	0	0

Bibliogrpahy

Academic Papers

Cowley, Lieutenant Colonel Aaron S. “The Evolution of the International System: Surrender Sovereignty or Fight to the Death.” School of Advanced Air and Space Studies, Air University, 2011.

Cox, Robert W. *Approaches to World Order*. Cambridge Studies in International Relations 40. Cambridge ; New York: Cambridge University Press, 1996.

Giovannini, Alessandro, and Giovanni Faleg. *The EU Between Pooling & Sharing and Smart Defence: Making a Virtue of Necessity?* CEPS Special Report. Brussels: Centre For European Policy Studies, May 2012. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2065198.

Overhage, Thomas. *Less Is More: Pooling and Sharing of European Military Capabilities in the Past and Present*. Thesis. Monterey, California: Naval Postgraduate School, June 2012. http://calhoun.nps.edu/public/bitstream/handle/10945/7398/12Jun_Overhage.pdf?sequence=1.

Parkinson, Stuart, Barnaby Pace, and Philip Webber. *Offenisve Insecurity: The Role of Science and Technology In UK Security Strategies*. Scientists for Global Responsibility, September 2013. http://www.sgr.org.uk/sites/sgr.org.uk/files/SGR_Offensive_Insecurity_%20exec_sum.pdf.

Valášek, Tomáš, and Centre for European Reform. *Surviving Austerity: The Case for a New Approach to EU Military Collaboration*. London: Centre for European Reform, 2011.

Articles

“Danish Planes in Libya Running Out of Bombs: Report.” *Defense News*. Accessed January 28, 2014. http://www.defensenews.com/article/20110609/DEFSECT01/106090302/Danish-Planes-Libya-Running-Out-Bombs-Report.

DeYoung, Karen, and Greg Jaffe. “NATO Runs Short on Some Munitions in Libya.” *The Washington Post*, April 16, 2011, sec. World. http://www.washingtonpost.com/world/nato-runs-short-on-some-munitions-in-libya/2011/04/15/AF3O7ElD_story.html.

“Embarrassment for MoD Because New £650million Spy Planes Cannot Refuel in Mid-air.” *Mail Online*. Accessed January 1, 2014. http://www.dailymail.co.uk/news/article-2266417/Embarrassment-MoD-new-650million-spy-Airseeker-planes-refuel-mid-air.html.

“First Rivet Joint Aircraft Delivered to the UK - News Stories - GOV.UK.” Accessed December 27, 2013. https://www.gov.uk/government/news/first-rivet-joint-aircraft-delivered-to-the-uk.

“Germany Axes Euro Hawk Drone Program.” *Defense News*. Accessed January 29, 2014. http://www.defensenews.com/article/20130514/DEFREG01/305140015/Germany-axes-Euro-Hawk-drone-program.

"Germany, UK Offer Alternatives to Global Hawk for NATO AGS." *Aviation International News*. Accessed January 29, 2014. http://www.ainonline.com/aviation-news/ain-defense-perspective/2013-06-14/germany-uk-offer-alternatives-global-hawk-nato-ags.

"DDG Type 45: Britains Shrinking Air Defense Fleet." *Defense Industry Daily*. Accessed January 28, 2014. http://www.defenseindustrydaily.com/ddg-type-45-britains-shrinking-air-defense-fleet-04941/.

Hvidt, Nanna, Hans Mouritzen, and Danish Institute for International Studies. *Danish Foreign Policy Yearbook 2012*. Copenhagen: DIIS, 2012.

Jakobsen, Peter Viggo. "Good News: Libya and the Danish Way of War." *Danish Foreign Policy Yearbook* 2012 (n.d.).

"Jobs to Go at UK Shipyards." *BBC*, November 5, 2013, sec. UK Politics. http://www.bbc.co.uk/news/uk-politics-24827403.

Kirkpatrick, Professor David. "Lessons from the Report on MoD Major Projects." *RUSI Defence Systems*, June 2009. http://www.rusi.org/downloads/assets/Acquisition_Issues_Lessons_from_the_MoD_RDS_Summer_09.pdf.

"Little England or Great Britain?" *The Economist*, November 9, 2013. http://www.economist.com/news/leaders/21589420-country-faces-choice-between-comfortable-isolation-and-bracing-openness-go.

Michell, Simon. "NATO Alliance Ground Surveillance Surges Forward." *RUSI Defence Systems* Autumn/Winter 2012 (January 29, 2013).

"NATO - A Global Perspective for Europe'' - Address by NATO Secretary General Anders Fogh Rasmussen to the Joint Meeing of the European Parliament's Committee on Foreign Affairs and Sub-committee on Security and Defence." *NATO*. Accessed November 7, 2013. http://www.nato.int/cps/en/natolive/opinions_86344.htm.

"NATO - Alliance Ground Surveillance (AGS)." *NATO*. Accessed January 29, 2014. http://www.nato.int/cps/en/natolive/topics_48892.htm.

Pepitone, Julianne. "Apple Spends Way Less Than Microsoft on R&D." *CNNMoney*. Accessed January 29, 2014. http://money.cnn.com/2013/11/20/technology/mobile/apple-rd-spend/index.html.

Professor Chalmers, Malcolm. *The Squeeze Continues - UK Defence Spending and the 2013 Budget*. Royal United Services Institute, March 25, 2013. http://www.rusi.org/analysis/commentary/ref:C51506B24A254C/#.UulrjChAvrU.

"Public Spending Chart for United Kingdom 2004-2017 - Central Government Local Authorities." Accessed February 25, 2014. http://www.ukpublicspending.co.uk/spending_chart_2004_2017UKb_30t#copypaste.

"Secret Report Criticizes NATO's Command in Libya." *Defense News*. Accessed January 28, 2014. http://www.defensenews.com/article/20121028/DEFREG01/310280001/Secret-Report-Criticizes-NATO-8217-s-Command-Libya.

"The Battle over Global Hawk." *Air Force Times*. Accessed January 29, 2014. http://www.airforcetimes.com/article/20130715/NEWS04/307150015/The-battle-over-Global-Hawk.

Work, Robert O., and Shawn Brimley. *20YY: Preparing For War in the Robotic Age*. Centre for a New American Strategy, January 2014. http://www.cnas.org/sites/default/files/publications-pdf/CNAS_20YY_WorkBrimley.pdf.

Books

Bijker, Wiebe E, and John Law. *Shaping Technology/building Society Studies in Sociotechnical Change*. Cambridge, Mass.: MIT Press, 1992. http://hdl.handle.net/2027/heb.01128.

Concise Oxford English Dictionary. 11th ed. New York: Oxford University Press, 2004.

Von Clausewitz, Carl. *On War*. Edited by Michael Howard and Peter Paret. Princeton: Princeton University Press, 2011. http://site.ebrary.com/id/10578581.

Dicken, Peter. *Global Shift: Mapping the Changing Contours of the World Economy*. 6th ed. New York: Guilford Press, 2011.

Gilpin, Robert. *War and Change in World Politics*. Cambridge; New York: Cambridge University Press, 1981.

Machiavelli, Niccolò. *The Art of War*. Wilder Publications, 2008.

Mearsheimer, John J. *The Tragedy of Great Power Politics*. New York: Norton, 2001.

Nardin, Terry, and David Mapel. *Traditions of International Ethics*. Cambridge; New York: Cambridge University Press, 1992.

Smith, Adam. *The Wealth of Nations*. New York: Random House Inc., 1937.

The Concise Encyclopaedia of Economics. Indianapolis, Ind: Liberty Fund, 2008.

Waltz, Kenneth N. *Theory of International Politics*. Long Grove, Ill.: Waveland Press, 2010.

Wendt, Alexander. *Social Theory of International Politics*. Cambridge Studies in International Relations 67. Cambridge, UK ; New York: Cambridge University Press, 1999.

Government Documents

Defence Industrial Strategy: Defence White Paper, December 2005. http://www.official-documents.gov.uk/document/cm66/6697/6697.pdf.

Great Britain, Ministry of Defence, Great Britain, and Parliament. *National Security through Technology: Technology, Equipment and Support for UK Defence and Security*. London: Stationery Office, 2010.

"Joint Concept Note 3/12, Future Air Space Operating Concept." Ministry of Defence, September 2012. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/49941/20120912jcn3_12_fasoc.pdf.

Reports

Great Britain. *Ministry of Defence: Providing Anti-air Warfare Capability: The Type 45 Destroyer*. Report / by the Comptroller and Auditor General, HC 295 session 2008-2009. London: Stationery Office, 2009.

Great Britain, National Audit Office, Great Britain, Parliament, and House of Commons. *The Major Projects Report 2012: Ministry of Defence : Report*. London: Stationery Office, 2013.

Great Britain, National Audit Office, Great Britain, Parliament, House of Commons, Great Britain, and Ministry of Defence. *Major Projects Report 2006: Report*. London: Stationery Office, 2006.

Great Britain, Parliament, House of Commons, Defence Committee, Great Britain, Parliament, and House of Commons. *Operations in Libya: Ninth Report of Session 2010-12. Vol. 1, Vol. 1,*. London: Stationery Office, 2012.

House of Commons Committe of Public Accounts: Management of the Typhoon Project. The House of Commons, April 4, 2011. http://www.publications.parliament.uk/pa/cm201011/cmselect/cmpubacc/860/860.pdf.

House of Commons Public Accounts Committee: Ministry of Defence Type 45 Destroyer. The House of Commons, June 23, 2009. http://www.publications.parliament.uk/pa/cm200809/cmselect/cmpubacc/372/372.pdf.

Major Projects Report 1999. National Audit Office Major Projects Report. London: The Stationary Office, July 6, 2000. http://www.nao.org.uk/wp-content/uploads/2000/07/9900613full.pdf.

Major Projects Report 2001. National Audit Office Major Projects Report. London: The Stationary Office, November 23, 2001. http://www.nao.org.uk/wp-content/uploads/2001/11/0102330.pdf.

Major Projects Report 2002. National Audit Office Major Projects Report. London: The Stationary Office, December 4, 2002. http://www.nao.org.uk/wp-content/uploads/2002/12/020391.pdf.

Major Projects Report 2003. National Audit Office Major Projects Report. London: The Stationary Office, January 23, 2004. http://www.nao.org.uk/wp-content/uploads/2004/01/0304195.pdf.

Major Projects Report 2004. National Audit Office Major Projects Report. London: The Stationary Office, November 10, 2004. http://www.nao.org.uk/wp-content/uploads/2004/11/03041159_II.pdf.

Major Projects Report 2005. National Audit Office Major Projects Report. London: The Stationary Office, November 25, 2005. http://www.nao.org.uk/wp-content/uploads/2005/11/0506595_II.pdf.

Major Projects Report 2007. National Audit Office Major Projects Report. London: The Stationary Office, November 30, 2007. http://www.nao.org.uk/wp-content/uploads/2007/11/070898ii.pdf.

Major Projects Report 2008. National Audit Office Major Projects Report. London: The Stationary Office, December 18, 2008. http://www.nao.org.uk/wp-content/uploads/2008/12/080964ii.pdf.

Major Projects Report 2009. National Audit Office Major Projects Report. London: The Stationary Office, December 15, 2009. http://www.nao.org.uk/wp-content/uploads/2009/12/091085ii.pdf.

Major Projects Report 2010. National Audit Office Major Projects Report. London: The Stationary Office, October 15, 2010. http://www.nao.org.uk/wp-content/uploads/2010/10/1011489_II.pdf.

Major Projects Report 2011. National Audit Office Major Projects Report. London: The Stationary Office, November 16, 2011. http://www.nao.org.uk/wp-content/uploads/2011/11/10121520-II-.pdf.

Major Projects Report 2013. National Audit Office Major Projects Report. London: The Stationary Office, February 10, 2014. http://www.nao.org.uk/wp-content/uploads/2015/02/The-Major-Projects-Report-2013.pdf.

Report by the Comptroller and Auditor General - Ministry of Defence: Collaborative Projects. Email from NAO, February 28, 1991.

Report by the Comptroller General: Management of the Typhoon Project. NAO Report, March 2, 2011. http://www.nao.org.uk/wp-content/uploads/2011/03/1011755.pdf.