



THE SIR RICHARD
WILLIAMS
FOUNDATION

INTEGRATED AIR & MISSILE DEFENCE STUDY

**The Challenge of
Integrated Force Design**



Air Vice-Marshal John Blackburn AO (Retd)

April 2017

Cover page illustration source

<https://commons.wikimedia.org/wiki/File:Peacekeeper-missile-testing.jpg> - time exposure showing the multiple re-entry vehicles deployed by one LGM-118A Peacekeeper missile being tested at Kwajalein Atoll in the Marshall.

National Library of Australia Cataloguing-in-Publication entry

Creator:	Blackburn, John, 1956- author.
Title:	Integrated air and missile defence : the challenge of integrated force design / AVM John Blackburn AO.
ISBN:	9780992341619 (paperback)
Subjects:	Air defenses--Australia. Ballistic missile defenses--Australia. Air warfare. Australia--Armed Forces

CONTENTS

Preface	.....3
Executive Summary	.....4
What Is IAMD? ... <i>the need for a Narrative?</i>	.....6
What Threats Are Prompting An Increased Priority For IAMD in the US?	.....9
What Is The US Doing About IAMD?; <i>are there lessons we can learn?</i>	.....11
What Is Australia Doing About IAMD? - <i>What else could be addressed?</i>	.....16
What Are The Lessons For Program-Level Capability Design?	.....19
Conclusions And Recommendations	.....24
A Final Thought	.....27
Major Sponsor Profiles	.....28

About the Williams Foundation:



The Sir Richard Williams Foundation is an independent research organisation whose purpose is to promote the development and effective implementation of national security and defence policies as they impact on Australia's ability to generate air power appropriate to its unique geopolitical environment and values.

The Foundation aims to strengthen Australia's national security by advocating the need for forward-looking policies which take full advantage of the potential for air power to shape and influence regional security; and by promoting constructive debate regarding the implementation of such policies.

<http://williamsfoundation.org.au>

About the Author :



Air Vice-Marshal John Blackburn AO (Retd) MA MDefStud

John retired from the Royal Australian Air Force in 2008 as the Deputy Chief of the Air Force following a career as an F/A-18 fighter pilot, test pilot and strategic planner. His senior posts included Commander of the Integrated Area Defence System located in Malaysia, commanding a multi-national headquarters established to effect the Five Power Defence Arrangements, and Head of Strategic Policy in the Defence Headquarters. He is now a consultant in the fields of Defence and National Security and is a member of the RAAF Reserve.

In his RAAF Reserve role, he supported the Chief of Air Force in the design of Plan Jericho in 2014, and served as the team mentor until December 2015.

His pro-bono roles have included being the Chairman of the Kokoda Foundation Board (*now the Institute For Regional Security [IFRS]*), and the Deputy Chairman of the Williams Foundation Board. He is currently a Fellow of both the Williams Foundation and the IFRS.

John has published reports on Cyber Security, Defence Logistics, Defence White Papers and Fuel Security. He holds a Masters of Arts and a Master of Defence Studies.

<https://www.linkedin.com/in/john-blackburn-ao-80324932/>

PREFACE

The Williams Foundation conducted an Integrated Air and Missile Defence (IAMD) study between Sep16 and Feb17 to explore the challenges of building Australia's IAMD capability and the implications for the Department of Defence's integrated force design function. The study was focussed at the Program level of capability.

The study incorporated a visit to the US for a month to explore the IAMD challenge with United States Defense Forces and Agencies, think tanks and Industry. The initial study findings were then explored in Australia in three Defence and Industry workshops on 31 Jan 17 and 1 Feb 17, using a Chatham House model of unattributed discussions. Many of the statements made in this report are not referenced as they are derived from these Chatham House discussions and associated meetings.

IAMD is a highly complex issue; comments made in this report should not be construed in any way as being critical of the IAMD approach of the Department of Defence. This report cannot account for the full complexity of the integrated force design process that is being addressed within Defence; however, it may offer some value in providing suggestions based on the study findings.

This study would not have been possible without the support and assistance of several areas within the Australian Department of Defence, the US Defense Department, Industry and think tanks. The Williams Foundation deeply appreciates the support of the IAMD Study major sponsors, Lockheed Martin and Northrop Grumman. Thanks are also due to Jacobs in funding the services of Dr Gary Waters who provided valuable support in the research for the study and in the production of the workshop notes.

This report represents the views of AVM Blackburn (Retd), the IAMD Study lead. This study report is intentionally high level and brief; in the author's experience, long and detailed reports are rarely read by senior decision makers.



NORTHROP GRUMMAN

JACOBS

Profiles of the IAMD Study major sponsors, Lockheed Martin and Northrop Grumman, are at the back of this report.

EXECUTIVE SUMMARY

The Integrated Air and Missile Defence (IAMD) Study addressed five questions. The study findings are summarised under each question.

What is IAMD?

IAMD is a complex issue. The 2016 Australian Government's Defence White Paper recognised the air and missile threat to deployed forces and the likelihood that it will increase in the years ahead. The Defence Integrated Investment Program (DIIP) listed an IAMD Program to be delivered in the period 2018-2030 with some \$2-\$3B allocated.

Whilst there is an IAMD Program identified in the DIIP, with component Projects listed, it is a list of equipment and systems and not a narrative or vision of what IAMD is and how we will operate to address the threat. We need an IAMD narrative to provide the context of, and focus for, our IAMD Program.

So, where can we look for a narrative? The United States *Joint Integrated Air and Missile Defense: Vision 2020* notes that at its core, IAMD is the integration of offensive and defensive operations against air-breathing and missile threats, meant to counter an enemy's ability to degrade or disrupt our operations and projection of combat power in a contested environment. The IAMD Vision emphasises that if deterrence fails, neutralising an adversary's offensive air and missile assets prior to use continues to be the preferred method to negate them and, with the current and projected growth in threats, is the only practical means to defeat large threat inventories. The *Joint Integrated Air and Missile Defense: Vision 2020* is clear and concise and could provide a good narrative on which to develop an IAMD Program for Australia.

What threats are prompting an increased priority for IAMD in the US?

US commentators have stated that "never has the United States faced a more complex or comprehensive global challenge in this area, and the forecast for 2020 and beyond is no more optimistic ... Success in negating it will take no less than a bold, holistic reimagining of America's IAMD."

It is apparent that the gap between the threat and the ADF's IAMD capability is growing and is likely to be larger in a decade than it is now, despite the significant level of investment the Government has committed to in the DIIP.

What is the US doing about IAMD / are there lessons we can learn?

Whilst the US Joint Vision for IAMD is impressive, the US is facing significant challenges in its execution. Understanding these challenges is important for Australia as we begin our IAMD journey with far less resources than are being applied to the challenge in the US.

This report describes these challenges and summarises *some* of the lessons gleaned from the US experience. The critical issue is that an IAMD Program cannot be built purely bottom-up if it is to be both effective and affordable; a top-down direction and focus is essential. There is a need for an IAMD Program Roadmap, that is a Directive and not only a recommendation.

There are clear leaders in the US in terms of IAMD systems thinking that can provide a path for Australia to follow, if we are prepared to accept a degree of developmental risk. The alternative is acquiring current technology IAMD components that are not suitable for the future threat environment, resulting in greater operational risk for the future force.

What is Australia doing about IAMD? - *What else could be addressed?*

Defence has a budgeted IAMD Program to be delivered in the timeframe 2018-2030. The first two IAMD related Projects to be considered under the new DIIP, AIR 6500 and Land 19 Phase7B, are closely coordinated and are focussed on the integrated outcome of the Projects.

The approach being adopted for the initial IAMD Projects is laudable; however, Defence is yet to develop an IAMD Program-level design that addresses the complexity of IAMD as a “System of Systems,” as has been done in the US.

Given the projected gap between threat and capability, simply executing the DIIP will not suffice if Australian Governments of the next decade wish to have the option of deploying forces into the Indo-Pacific region. Defence will need to approach the challenge somewhat differently than it has done to date. A top-down IAMD Program design will afford the opportunity to maximise our IAMD capability and address the growing threat-capability gap.

At first glance, it seems obvious that an IAMD Program design should be developed as a matter of priority. However, it is difficult to see how an IAMD Program can be designed *by itself* without concurrently considering many of the other Programs in the new Defence Program Structure; the reality is that an IAMD Program incorporates component capabilities of many other Programs.

What are the lessons for Program level capability design in Australia?

Trying to “design” 40 highly interlinked and inter-dependent Programs separately would seem to be an impossible task. This challenge gives rise to the question of whether or not the Defence Program structure, as currently employed, enables integrated force design by individual Programs? The conclusion reached in this study is that the integrated design of the future Defence force needs to start at the Capability Stream level. Once that work is done, subordinate Program designs can be developed. There needs to be an integrated team that performs this function; however, if this cannot be resourced then a top-down design will remain an unfulfilled aspiration.

Recommendations

This report recommendations include:

- Defence should commence the design of the integrated force at the Capability Stream level first.
- The design of the IAMD Program should be a priority and should be guided by integrated force design at the Capability Stream level. The resulting IAMD Program Roadmap needs to be a Directive rather than just a recommendation.
- The IAMD Program needs to identify the Strategy and Roadmap for IAMD to address issues such as who we follow and what level of acquisition risk is appropriate, given the operational risks we may face in the future.

WILLIAMS FOUNDATION IAMD STUDY REPORT

The Integrated Air and Missile Defence (IAMD) Study addressed five questions. The study findings are summarised under each question.

WHAT IS IAMD? ... *the need for a Narrative*

IAMD is a complex issue. It is not just a matter of acquiring pieces of equipment and systems that can be used together to address a growing security threat. As we will discuss in this report, it is much more than that. Building a shared understanding of what IAMD is, the threats we will face in the future and how we, together with our allies, will need to operate to address that threat is the first step in understanding what IAMD is and what we must do to address the threat.

The research for this study looked for a public narrative or vision about IAMD and what we in Australia are doing to address the threat. That narrative is yet to be written for Australia's IAMD Program. That does not mean that the Australian Government and our Department of Defence are not addressing the issue, they are. There is significant effort and investment being applied to the IAMD challenge as detailed in the 2016 Defence White Paper (DWP) and the associated Defence Integrated Investment Program (DIIP).

The 2016 DWP recognised the air and missile threat to deployed forces and the likelihood that it will increase in the years ahead. It noted that to respond to these developments we must increasingly develop capabilities which can protect our forces when they are deployed across large geographic areas, particularly in air and missile defence and anti-submarine warfare, and better link the ADF's individual capabilities to each other.¹ The Government has committed to upgrade the ADF's existing air defence surveillance system, which could be used as a foundation for development of deployed, in-theatre missile defence capabilities, should future strategic circumstances require it.

The DIIP identifies capability components of an IAMD capability, including the upgrade of the ADF's existing air-defence systems, including command, control, communications, computers and intelligence (C4I) systems and sensors. It states that Defence will also develop a Joint Battle Management System to better coordinate and synchronise ADF operations and that the future ground-based air-defence system will replace the RBS-70 with a short-range man-portable surface to air system by the early 2020s, to be supplemented later by a medium-range surface-to-air missile system in the mid to late 2020s, providing a layered air-defence against a broad range of capable air threats.² Table 7 of the DIIP lists an IAMD Program to be delivered in the period 2018-2030 with some \$2B-\$3B allocated.

Defence has a budgeted IAMD Program identified with some component capabilities listed in the DIIP; however, it is a list of funded equipment and systems and not a narrative or vision of what IAMD *is* and how we will operate to address the threat. Does that matter?

¹ Department of Defence, *2016 Defence White Paper* (Canberra: Commonwealth of Australia, 2016), para 2.45

² Department of Defence, *2016 Integrated Investment Program* (Canberra: Commonwealth of Australia, 2016), paras 5.23 – 5.28

This report argues that the lack of a narrative is an issue for two reasons:

- Firstly, Defence now has a structure for capabilities that groups Projects into “Programs” that allow for the context of a Project to be understood and to address how capabilities will work in an integrated manner to deliver the required operational effects. A narrative of what the Program is trying to achieve and how the capabilities will need to work collectively is necessary to provide that context and to be able to communicate that context to Government. The Government could consider investment decisions by Program and not by individual Projects, as is currently the case.
- Secondly, without a clear narrative to set the context, it is virtually impossible to develop an integrated Program-level design for our IAMD capability.

So, where can we look for a narrative? Perhaps to the United States ... the five-page 2013 United States *Joint Integrated Air and Missile Defense: Vision 2020*³ envisages that all capabilities including defensive, passive, offensive, kinetic, non-kinetic (cyber warfare, directed energy, and electronic attack) are melded into a comprehensive joint and combined force capable of preventing an adversary from effectively employing any of its offensive air and missile weapons. At its core, IAMD is the integration of offensive *and* defensive operations against air-breathing and missile threats, meant to counter an enemy’s ability to degrade or disrupt our operations and projection of combat power in a contested environment.

At its core, IAMD is the integration of offensive *and* defensive operations against air-breathing and missile threats, meant to counter an enemy’s ability to degrade or disrupt our operations and projection of combat power.

The *Joint Integrated Air and Missile Defense: Vision 2020* emphasises that if deterrence fails, neutralising an adversary's offensive air and missile assets prior to use continues to be the preferred method to negate them, and with the increasing growth in numbers, is the only practical means to defeat large threat inventories. **This link between offensive and defensive operations for IAMD is critical.** It notes that it will require the horizontal integration of component capabilities, and the vertical integration of policy, strategy, concepts, tactics, and training. The Joint Vision concludes by stating that to succeed in IAMD, the US must offset fewer resources with more innovation to develop and maintain an affordable, integrated, interdependent Joint and combined approach. Investments should follow a well-reasoned, cost-balanced course, leveraging innovations in employment of kinetic and non-kinetic measures that embrace a wide spectrum of active and passive pre- and post-launch solutions. Importantly, it notes that the US IAMD capability must be **designed from the beginning to be interoperable.**⁴

The *Joint Integrated Air and Missile Defense: Vision 2020* is clear and concise and could provide a basis on which to design an IAMD Program for Australia. Readers with an interest in this topic should refer to <http://www.jcs.mil/Portals/36/Documents/Publications/JointIAMDVision2020.pdf>

³ *Joint Integrated Air and Missile Defense: Vision 2020*, 5 December 2013.

⁴ *Ibid.*, page 5.

There are some critical points that merit re-emphasis, in particular that of IAMD comprising integrated offensive *and* defensive operations and that it must be *designed from the beginning to be interoperable*. This is particularly important in light of the growing threat forecasts discussed later in this report.

The diagram below provides a model of the US Joint IAMD spectrum of operations. Left of Launch refers to the negation of an adversary's offensive air and missile assets *prior* to use.



Given that this is an Australian report, a sporting analogy is appropriate. So, imagine that you are playing cricket and you are the batsman. Unfortunately, the laws of the game are changing and instead of facing one bowler, you are now facing 10, concurrently. They are also not using a standard size ball that you can see easily and some of the balls are moving at hypersonic speeds. Option A is to swing wildly and hope that you hit something. This, in IAMD terms, is called “right of launch.” Option B is to use the other batsman at the bowler’s end of the cricket pitch to target the bowlers as they run up to bowl and to have the remainder of the batting team run onto the field at the bowlers. At a minimum they will be distracted; ideally some will no longer be able to bowl. The end result is that your batting problem is significantly reduced. This, in IAMD terms, is called “left of launch.”

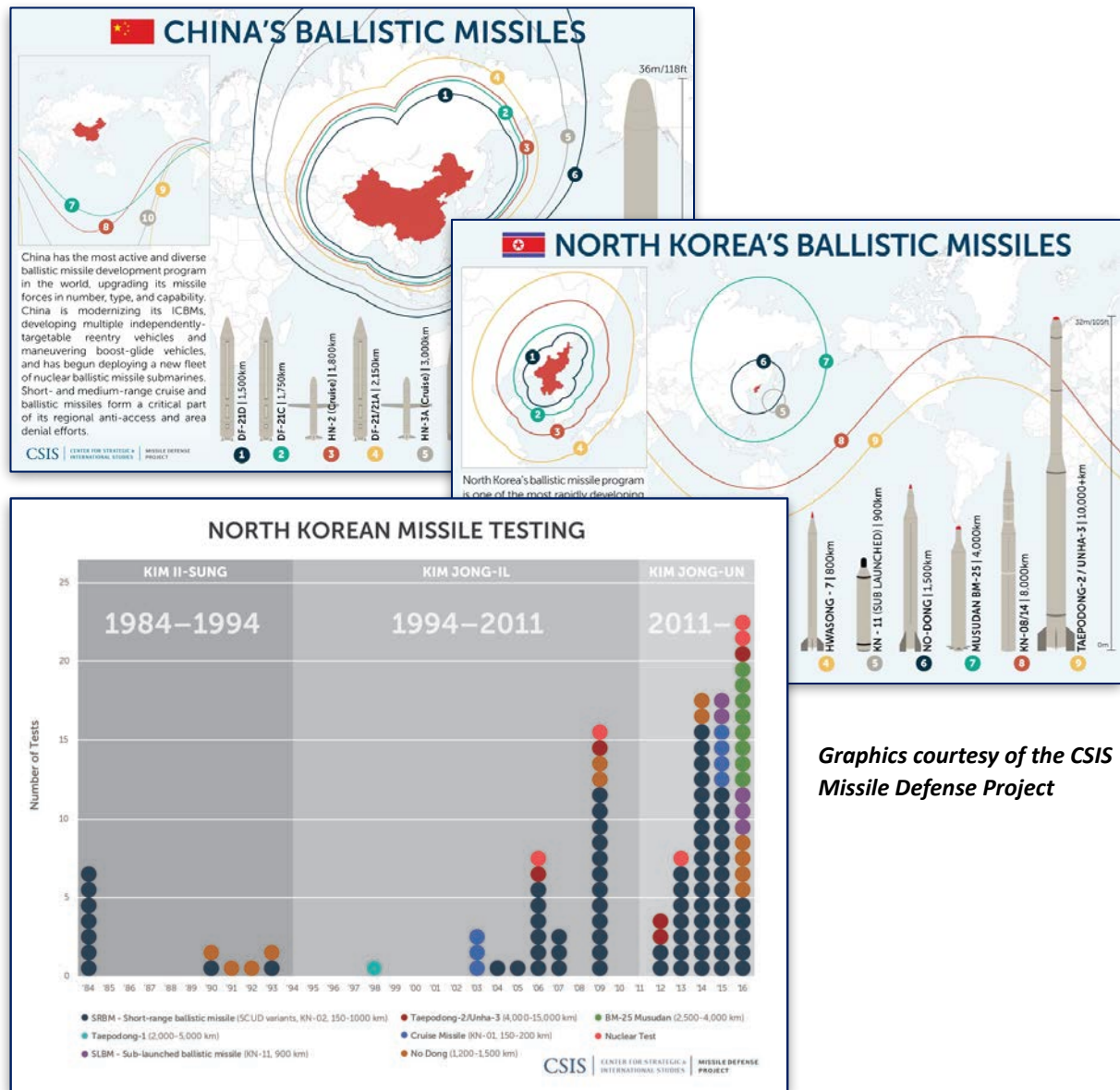


If your life depended on the game’s outcome, you would ensure that your IAMD Program design included left of launch. Whilst some purists would argue that the analogy is not cricket; going to war without an integrated left of launch capability is not smart.

Finally, IAMD is not a single-Service role, despite the “Air” terminology and the assignment of the lead of the IAMD Program to the Air Force; IAMD is a shared responsibility that will require integrated operations between all three Services, supported by Government Agencies, and integrated, where appropriate, with allied and coalition forces.

WHAT THREATS ARE PROMPTING AN INCREASED PRIORITY FOR IAMD IN THE US?

The future IAMD environment will be characterised by a full spectrum of air and missile threats – ballistic missiles (*such as those of China and North Korea illustrated below*), air-breathing threats (*cruise missiles, aircraft, Unmanned Aircraft Systems*), long-range rockets, artillery and mortars, utilising a range of advanced capabilities such as stealth, electronic attack, manoeuvring re-entry vehicles, decoys, and advanced terminal seekers with precision targeting. These threats will continue to evolve, increasing the stress on all areas of defences and expanding the scope of IAMD operations.



Graphics courtesy of the CSIS Missile Defense Project

Never has the United States faced a more complex or comprehensive global challenge in this area, and the forecast for 2020 and beyond is no more optimistic ... a dire and growing air and missile threat to the United States and its interests around the world. Success in negating it will take no less than a bold, holistic reimagining of America's IAMD.⁵

⁵ Geoffrey F. Weiss, *Seeing 2020: America's New Vision for Integrated Air and Missile Defense*, Joint Force Quarterly 76, 30 Dec 14.

Over the next two decades, at least half of the world's advanced combat aircraft armed with extended range missiles and supported by highly sophisticated information networks, will be operated by Indo-Pacific countries.⁶ Some regional countries can be expected to acquire longer-range precision guided missiles, including ship-based missiles. New weapons, many not yet conceived, can also be expected to enter the region, resulting from technological advances in areas such as quantum computing, innovative and additive manufacturing, hypersonics, directed energy weapons, and unmanned systems. The threat is changing, and in some cases, changing quite rapidly.⁷ For example, China and Russia are accelerating the development of air-breathing and boost-glide hypersonic weapons systems, and both are believed to be targeting 2020 for deployment of the first operational units.⁸ Threats now combine speed and manoeuvrability with range and accuracy, and hypersonic missiles exacerbate the threat as they go beyond purely ballistic trajectories and thus will need new approaches to defeat them. The evolving threat is not a traditional one; hence the response needs to be non-traditional across all dimensions (*including operations, acquisition and sustainment*) as well as the warfighting domains.

A growing debate in the United States is the issue of how to develop a robust yet affordable IAMD system. In his CSIS paper *Getting to the Elusive "Right Side of the Cost Curve"*, BGEN Todorov (USAF Ret) noted that "the US and its partners will face not only ballistic threats but also low-cross-section cruise missiles and other air-breathing threats ... wars are not fought in stovepipes, yet we are largely developing capabilities that way, without putting much thought into how to fold in other elements of the integrated air equation." He noted that "Given that an adversary may be able to launch large numbers of relatively inexpensive yet increasingly complex missiles, reducing the cost to produce very expensive weapons systems or finding less expensive ways to intercept these adversarial missiles is paramount."⁹

The informed view discussed in the IAMD study workshops was that the gap between the threat and the ADF's IAMD capability is growing and is likely to be larger in a decade than it is now, despite the significant level of investment the Government has committed to in the DIIP. This is not a problem unique to Australia, it is common challenge faced by Western forces; as the US Joint IAMD Vision 2020 notes: "IAMD systems are expensive by nature – we simply will not be able to afford everything we need."¹⁰

The gap between the threat and the ADF's IAMD capability is growing and is likely to be larger in a decade than it is now, despite the significant level of investment the Government has committed to in the DIIP. Simply executing the DIIP will not suffice.

⁶ Department of Defence, 2016 Defence White Paper, , para 2.41.

⁷ Since the most recent Force Structure Review was completed in 2014 (in support of the 2016 Defence White Paper), the strategic situation has evolved such that several ballistic and cruise missile programs have emerged that were not envisaged in 2014.

⁸ Guy Norris, *Classified Report on Hypersonics says US Lacking Urgency*, AW&ST, 14 Feb 17.

⁹ BGEN Kenneth E. Todorov (USAF ret), *Getting to the elusive "Right Side of the Cost curve"*, CSIS Missile Defense Project, April 2016, Pages 6-7.

¹⁰ *Joint Integrated Air and Missile Defense: Vision 2020*, 5 December 2013, page 1.

So, what does this mean for Australia? Simply executing the DIIP as a list of Projects will not suffice if Australian Governments of the next decade wish to have the option of deploying forces into the Indo-Pacific region in an environment where the IAMD threat is growing rapidly; we will need to approach the challenge somewhat differently than we have done to date. As will be discussed later in this report, a broader range of approaches will be required to mitigate this changing threat landscape, including the Command and Control (C2) arrangements to better synchronise and coordinate all available systems, including left of launch measures.¹¹ This change in approach will necessitate revised thinking around Concepts of Operation (CONOPS), integrated design, acquisition and sustainment but will, initially, need a better understanding of how the gap can be closed across the range of possible responses, including systems, processes and people.

WHAT IS THE US DOING ABOUT IAMD; *are there lessons we can learn ?*

The United States Department of Defense's Joint Vision for IAMD provides a clear and concise description of IAMD and the US Government's intent. The US Joint Integrated Air and Missile Defence Organisation (JIAMDO) has been set up to manage the US IAMD portfolio, and to identify and coordinate requirements to support efforts to develop IAMD solutions for the warfighter.¹² JIAMDO also develops and maintains the IAMD roadmap; identifies and develops IAMD operational concepts, joint requirements, system interoperability, and operational architectures; assesses and validates IAMD capabilities by means of simulations, technology demonstrations, and exercises; and advocates for the warfighters' desired IAMD capabilities within the requirements and investment processes.

The US framework is impressive and yet it is facing significant challenges in execution. This statement is not meant to diminish the US IAMD Program, but rather to highlight the significant challenge that IAMD poses. Recognising these challenges is important for Australia as we begin our IAMD journey with far fewer resources than are being applied to the challenge in the US. This report will highlight *some* of the lessons identified in the US IAMD Programs and suggest what approaches may be adopted by Australia to learn from the US experience.

IAMD Direction. Significant resources have been applied in the US to IAMD. For example, the JIAMDO initially had around 130 people in the organisation focussed on the IAMD challenge; in contrast, in Australia, we would have fewer than 5 people focussed on an IAMD Program at the strategic headquarters level. Despite the US's clear vision and applied resources, there are still difficulties in building a shared understanding of their way ahead in terms of what is needed and when. One issue that the JIAMDO faces in its task is that, as Joint staff, their IAMD Roadmap remains a *recommendation, but not a directive* and whilst their guidance is influential in the budgeting process, there is no direct control over the

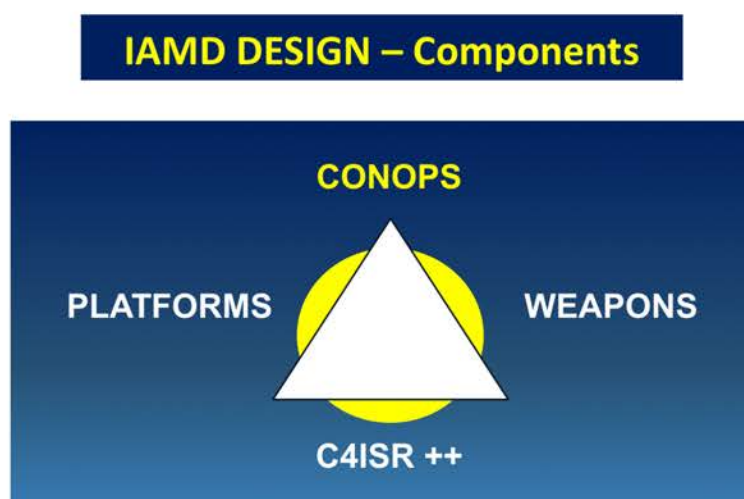
¹¹ Left of Launch refers to the negation of an adversary's offensive air and missile assets prior to use; the US Joint IAMD Vision 2020 notes that the link between offensive and defensive operations for IAMD is critical.

¹² The Australian Department of Defence does not have a JIAMDO equivalent, despite the Government commitment to invest billions of dollars in IAMD over the next decade. That said, the formation of an organisation the size and complexity of the JIAMDO would not be feasible for a Defence Force the size of Australia's; however, the need for some form of **resourced** organisation that takes responsibility for the integrated oversight of Programs, such IAMD, is necessary.

Service budgets which drive capability acquisition. A lesson for Australia in this case is that there needs to be an IAMD Roadmap, built by an integrated Defence team, that is a Directive and not just a recommendation. The smaller size of our Defence Bureaucracy and the formation of the Defence Headquarters in mid 2017 should make an *integrated* IAMD directive, to which all Services and Agencies sign up to, feasible. *This lesson could apply to all Programs and not just IAMD.*

There needs to be an IAMD Roadmap, that is a Directive and not just a recommendation.

IAMD Design. To explore IAMD, the study used the simple model illustrated below, whereby IAMD was viewed through the components of Platforms, C4ISR and Weapons with an integrating IAMD CONOPS. The essence of being “*Integrated*” in an IAMD capability is to ensure that all of the essential components are given appropriate consideration. The USAF Air Superiority 2030 Flight Plan Report highlighted “innovations must be paired with valid concepts of operation to make them effective in the expected operational environment”.¹³ The integrating CONOPS is an essential component that is missing in the Australian consideration of IAMD.¹⁴



Examples of the US experience / issues related to these IAMD components that Australia could learn from include:

- A top-down, integrated design across the IAMD components is necessary for force effectiveness and for formal US certification of the kill chain to assure interoperability / integration with US Forces where appropriate. This implies the need for an IAMD architecture, based on a CONOPS, that is established early in the design process.

¹³ USAF Air Superiority 2030 Flight Plan, Enterprise Capability Collaboration Team, May 2016

¹⁴ Whilst Defence has an Operational Concept for the 1 to 10 year timeframe, the AJOC, and a classified IAMD Operational Concept, there is not a Concept of Operations (CONOPS) for IAMD. A CONOPS should deal with the “how” the ADF will operate in sufficient detail to support the development of Force Architectures.

- Whilst C4ISR is the “glue” of an IAMD capability, IAMD is a lot more than just C4ISR. It cannot be built with a narrow focus on one component or element of an IAMD system.

Whilst C4ISR is the “glue” of an IAMD capability, IAMD is a lot more than just C4ISR. It cannot be built with a narrow focus on one component or element.

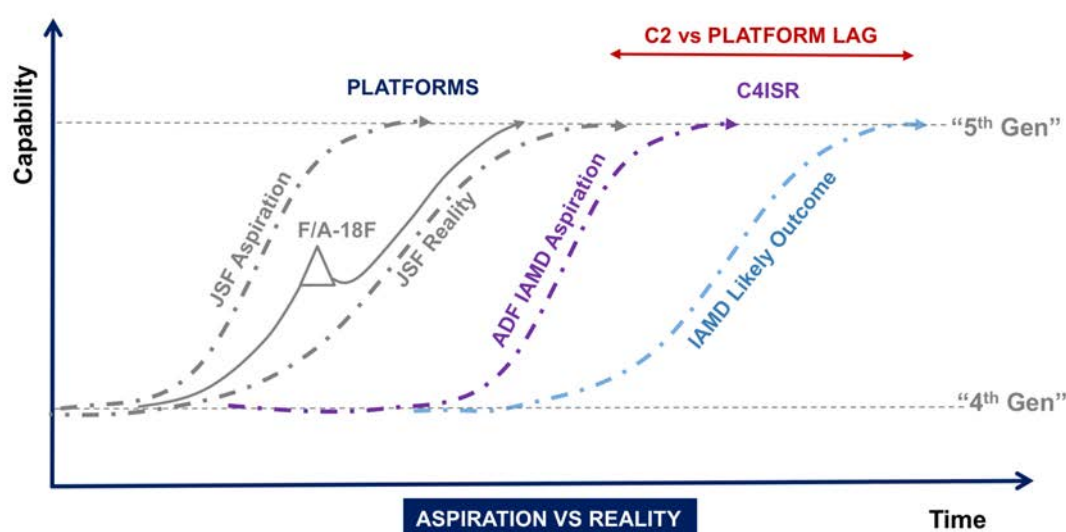
- The US experience indicates that most current US C4ISR systems are developed in a bottom-up fashion and integrated in an “after-market” manner because they are being acquired in stand-alone, stove-piped Projects with little apparent “5th Generation” battle management thought-leadership evident.
- The reality of stove-piped development priorities in some ADF capabilities; e.g., those of the Joint Strike Fighter, may result in key platform or sensor systems not being fully integrated into the broader IAMD system on introduction to service. Therefore, analysis of such platform systems is essential as a part of the ongoing IAMD design process to ensure that platform upgrades do, in time, address critical IAMD integration requirements. For example, prioritisation of future JSF upgrades to ensure that sensor information can be fully shared with other platforms and systems where necessary for IAMD purposes, would improve Force survivability in a future air and missile threat environment.
- **IAMD Open Systems Architecture (OSA)** - Lessons from existing US C4ISR systems have highlighted that integration is seriously hindered without well-defined and documented interfaces; indeed, some systems have had to be re-engineered using OSAs to ensure operational effectiveness. An OSA approach would provide an adaptable and readily upgradable technology basis for new and legacy platforms. Using COTS hardware and software as the architectural basis, OSA would support the rapid development and integration of new platform capabilities. Selecting an OSA approach across multiple platforms or across the enterprise, sets the stage for rapid capability insertion, software commonality and reuse, and interoperability. The key to obtaining transient operational advantage in the future (to use a RAAF Plan Jericho term) will be the adoption of an OSA-based design. A lesson for Australia is that the early adoption of an OSA standard, or standards, cognisant of the OSA systems we already have in service or are acquiring, will be essential for our IAMD Program. *This lesson could apply to all Programs and not just IAMD.*

The IAMD Program cannot be built purely bottom-up if it is to be both effective and affordable; a top-down direction and focus is essential.

➤ **Cybersecurity.** It is critical to recognise that Cybersecurity requires a ‘systems of systems’ approach that is managed architecturally and cannot be addressed separately by each Project. Cybersecurity cannot be simply added to an IAMD system “later.” Given the unclassified nature of this report, it is not appropriate to delve deeply into the cybersecurity aspects of a future IAMD system; however, what is evident is that a bottom-up approach to building an IAMD Program, Project by Project without a Program-level architecture, will result in unacceptable cybersecurity risks.¹⁵ *This issue does apply to all Programs and not just IAMD.*

A bottom-up approach to building an IAMD Program, Project by Project without a Program-level architecture, will result in unacceptable cybersecurity risks.

IAMD Systems Feasibility Timeline. It became evident during the IAMD study that the issue of “aspiration versus reality” may not have been given enough focus, particularly in the DIIP. The diagram below is an attempt to represent the time gap between aspiration and reality for capabilities which comprise two of the three IAMD Program components addressed in this study, platforms and C4ISR. If we examine the aspiration versus reality of the JSF Project, for example, where the Air Force goal is to transition to a “5th Generation” capability, we can observe a significant delay in the delivery of the capability which the Australian Government decided to offset with the acquisition of the F/A-18F Super Hornets as a risk mitigation measure. It would not be an exaggeration to recognise that the lag between “5th Generation thinking” about platforms, such as the JSF, and that of C4ISR systems is considerable. The ADF has a capability aspiration for IAMD C4ISR components that frankly is well in advance of what is currently *available* on the market in the US (*such systems are in development.*) “5th Generation thinking” with respect to many weapons systems is further in lag. Given that weapons are the IAMD component that actually produces the end result, that lag in design thinking is a concern.



¹⁵ Valuable Information Assurance expertise is being developed in the civil and educational sectors in Australia. For example, see <https://www.unsw.adfa.edu.au/australian-centre-for-cyber-security/research-themes/technologies-cyber-security-information-assurance-and-situational-awareness>

Who could we follow? To examine who is making clear progress in the IAMD arena, we need to look beyond the component technologies to the design of the IAMD system itself. There are clear leaders in the US in terms of IAMD systems thinking that can provide a path for Australia to follow. These include the USN's Navy Integrated Fire Control–Counter Air (NIFC-CA)¹⁶ Program, the US Missile Defence Agency's Command and Control, Battle Management, and Communications (C2BMC) Program and the US Army's IAMD Battle Command System (IBCS) Program. The USN is coordinating with the USAF on NIFC-CA and there are calls for coordination between NIFC-CA and the US Army's emerging IBCS.¹⁷ Such Programs could inform the design of an integrated capability to meet Australia's requirements if we are prepared to accept a degree of developmental risk, albeit much lower than if we were leading the development ourselves. The alternative is acquiring current technology IAMD components that are not suitable for the future threat environment resulting in greater operational risk for the future force as we try to integrate those components in an after-market manner.

Integrated Fire Control (IFC) refers to the participation, and coordination, of multiple distributed sensors and weapons in tactical engagements of enemy targets. For example, it enables the:

- **selection of the best weapon/s and the best sensor/s to work together to improve the probability of destroying a target and thereby maximise the effect of a limited number of weapons.**
- **shooter to fire a weapons at a target beyond its own sensor coverage.**
- **continued operation of a weapons platform after its own weapons have been fired, e.g. a JSF could continue to provide valuable situational awareness and to engage targets using off-board weapons.**

¹⁶ The USN has aggregated capabilities under three principal pillars: battlespace awareness, assured command and control, and integrated fires; these three pillars are the underpinnings for IAMD in particular. The US Navy has developed its Navy Integrated Fire Control–Counter Air (NIFC-CA) capability that provides integrated fire control for theatre air and anti-ship cruise missile defence in the tactical environment. The capability greatly expands the over-the-horizon air warfare battlespace for surface combatants to enable third-party targeting and use of smart missiles.

¹⁷ The US PACOM Commander, Admiral Harris, recently reiterated his desire to have the Army's IAMD system (IBCS) integrate with the Navy's NIFC-CA - <http://breakingdefense.com/2017/02/link-army-navy-missile-defense-networks-adm-harris/>

WHAT IS AUSTRALIA DOING ABOUT IAMD? - *What else could be addressed?*

As noted previously, Defence has a budgeted IAMD Program with some \$2B-\$3B allocated for an IAMD Program to be delivered in the period 2018-2030. Some of the first IAMD related Projects to be considered under the new DIIP are AIR 6500 (*upgrading of existing air-defence systems including command, control, communications, computers and intelligence (C4I) systems and sensors*) and Land 19 Phase 7B (*replacing Army's Ground Based Air Defence missile system.*) The Projects are closely coordinated and are focussed on integrated outcomes rather than purely individual Project goals.

The approach for these two Projects, in particular, is a good example of what Air Marshal Davies, the Chief of Air Force (CAF), discussed during his recent launch of the Air Force's Strategy : "*I would like Air Force in a joint context to begin to put the joint effect before our own Air Force requirements. I want Army, Navy, APS and other agencies to know intimately what Air Force can do for them.*"¹⁸ Air Force is putting the joint effect first in its approach to AIR 6500.

The CAF's intent is particularly important, given historical approaches to interoperability priorities. It is evident, from the IAMD workshop discussions, that the priorities for some ADF Services in the past have been for interoperability with their sister Services in the US, vice within the ADF. That focus needs to change to ensure that equal interoperability / integration priority is afforded to the joint effect that our Forces will need to achieve.

So, if the initial Project coordination appears to be effective, why change anything, why do something different? There are two reasons.

- Firstly it is apparent that simply implementing the Projects listed in the DIIP will not suffice; despite the significant investment commitment made by the Australian Government the gap between the threat and the ADF's IAMD capability gap is likely to be larger in a decade than it is now. We will need to do *something* different if we are to achieve the required level of IAMD capability in the future.
- Secondly, the experience of the US is that an effective IAMD capability cannot be built purely bottom-up from a narrow Project perspective; if it is to be both effective and affordable, a top-down direction and focus is essential. The approach being adopted for the initial IAMD related Projects is laudable; however, Defence is yet to define an IAMD Program-level design that addresses the complexity of IAMD as a "System of Systems," as has been done in the US. A top-down approach will afford the opportunity to maximise our IAMD capability and address the growing threat-capability gap.

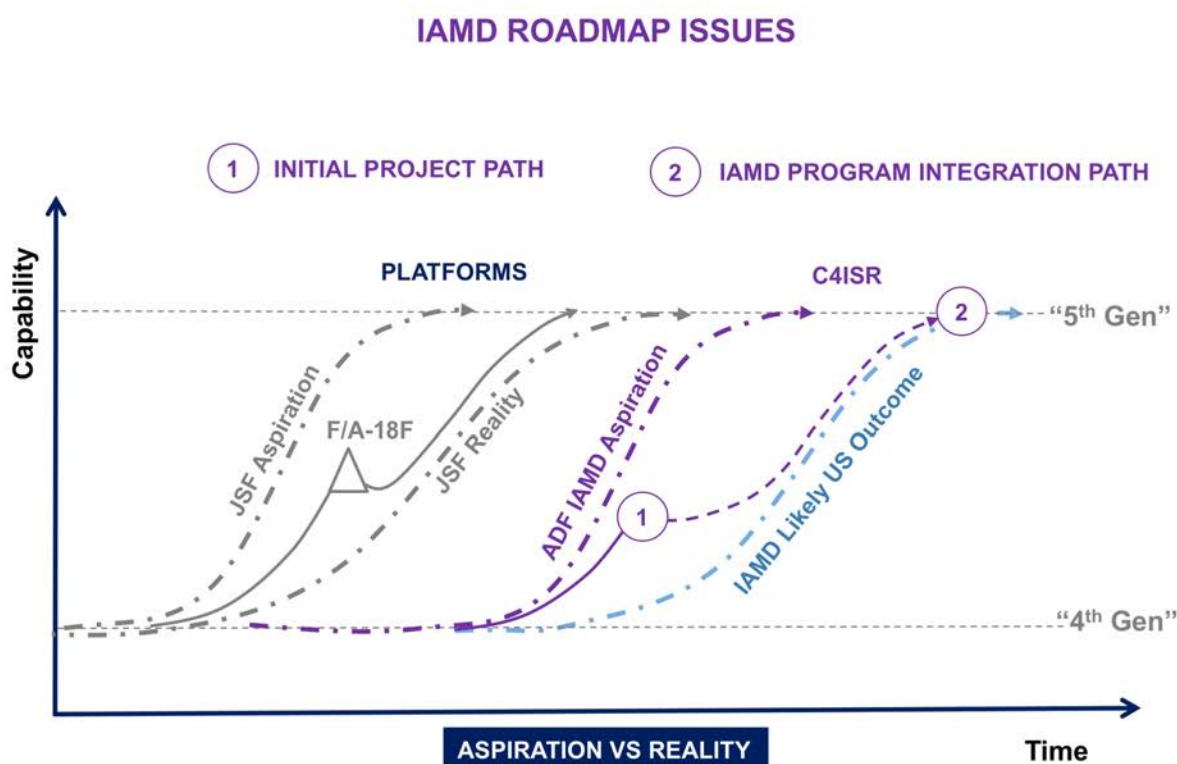
The development of such a design will require us to first understand the complexity of the IAMD challenge *for us* and to develop a narrative or vision of what IAMD is and how we may operate to address the threat. Defence faces its own unique set of challenges in integrating the bespoke and extant communications and C2 elements within Australia and the ADF with the systems being acquired *such as* the JSF, the SEA 4000 Air Warfare Destroyer with its Aegis System, SEA 5000 Future Frigate with the Australian developed CEA radar, AIR 6500, Land 19 Ph7B, the P8 and the Triton, the F/A-18 SuperHornet and the Growler, and the E-7 Wedgetail. These are only some of the systems that will need to be integrated whilst addressing cyber security demands and whilst implementing concepts such as Live/Virtual/Constructive training.

¹⁸ RAAF Air Force news, Vol.59, No.1, February 9, 2017, pp.4-5.

Are we at risk of relearning the lessons of the US IAMD experience? In the absence of an integrated design, we could acquire IAMD components in a stove-piped or clustered fashion, deferring the full system integration of the IAMD Program to an “after-market” problem and incurring unnecessary future operational risk and considerable additional cost as a result. *This lesson could apply to all Programs and not just IAMD.*

The main recommendation that emerged from the initial study research was that an IAMD Program-level design needs to be developed as a matter of priority in order to provide a top-down, integrated design across all IAMD component and related Projects. This recommendation implies, *at first glance*, the development of an IAMD narrative, CONOPS guidance, and architectures. Whilst the US IAMD vision and resulting JIAMD guidance provides a good template for Australia, it needs to be adapted for Australia’s specific needs and circumstances.

The Australian IAMD Program needs to develop a Roadmap for IAMD that addresses issues such as who we follow and what level of acquisition risk is appropriate given the operational risks we may face in the future. Such a Roadmap should identify initial Project steps and how we will eventually integrate with the future US IAMD Program, as illustrated below.



The IAMD study also identified a number of key questions and issues that should be addressed in addition to CONOPS, C4ISR++, Platforms and Weapons, in the Australian context, as a part of the IAMD Program design process. Defence has been provided with a more comprehensive list; however, examples of these additional questions/issues are as follows.

- **Integration vs Interoperability.** An IAMD Program design will require decisions to be made such as: what has to be integrated with the US, and what simply has to be interoperable. With the increasing threat, greater integration will be needed with allies for some capabilities and systems. For example, the ADF will utilise national and coalition sensors to take advantage of the entire force's situational awareness to help orientate the Commander and to support coordinated decisions across the Joint force, which will employ effectors, both kinetic and non-kinetic. IAMD systems and the associated IAMD architecture must support this level of integration.
- **People.** A major concern identified is that of the people who will operate and support the future IAMD system. It is evident that the US does not have sufficient C2 trained personnel to do the job; this, and their training, is a key limiting factor. It is important that Australia determines up-front if the IAMD systems identified and funded in the DIIP will be supported by sufficient numbers of people trained to perform the critical IAMD roles and to support the IAMD systems.
- **Acquisition and Sustainment** models were highlighted as a significant risk factor. For example, the USAF *Air Superiority 2030 Flight Plan* Report¹⁹ noted the need to implement acquisition approaches that match the tempo of technology development cycles. The report's lead author BGEN Alex Grynkeiwich states "if the (US) Department of Defense does not change its acquisition approach, our capability development will be outpaced by others around the world. We are already behind in many areas, and we must act now or our remaining technological advantages will continue to erode ... we must improve our ability to develop and field capability in the information age or we will not win the 2030 fight."²⁰ There is a need to review Australia's acquisition and sustainment models to determine if they are fit for purpose for this next generation of capabilities, such as IAMD, and flexible enough to cope with the rate of threat growth, particularly given that Australia's Defence industry base is significantly smaller than that of the US. Defence cannot build and operate an integrated force using business models developed for acquiring and sustaining stand-alone, stove-piped capabilities. Parallel development, spiral development, capability insertion, evolutionary acquisition and sustainment all need to be incorporated into the way of the future. *This issue applies to all Programs and not just IAMD.*

Before discussing how Defence could go about designing the overall IAMD Program, it should be recognised that there are timing imperatives for a number of IAMD related Projects, such as Land 19 Phase 7B, which are acquiring capabilities to address significant, existing, capability deficiencies. It is therefore important to recognise that any proposed Program design actions should not inadvertently impede the timely delivery of high-priority

¹⁹ USAF *Air Superiority 2030 Flight Plan*, Enterprise Capability Collaboration Team, May 2016

²⁰ BGEN Alex Grynkeiwich, *The Future of Air Superiority, Part IV, Autonomy, Survivability, and Getting to 2030*, <https://warontherocks.com/>

near-term Projects; they need to be developed concurrently and then integrated. The Program design function needs to catch up with Projects underway, not impede them.

The Program design function needs to catch up with Projects underway, not impede them.

So, how do we address IAMD Program design without over-complicating the issue? We return here to the thoughts of the CAF, Air Marshal Davies, who recently discussed building Defence capability using a mental model of a “town plan.” He portrayed Projects as “streets” in a town. They lead forward, are key parts of the town but they need an overall town plan which guides how the streets are aligned and how they integrate with the common services, power, water, sewerage, that all “streets” need and that cannot be installed afterwards without significant costs and disruptions. The town plan can be seen as an analogy for Program-level design. This approach is easy to visualise and therefore more likely to be more useful for some, than the current Defence Program structure and design process.

What could the town plan look like? Can there be a town plan just for IAMD? As noted previously, most, if not all, of the issues and questions that arose in the IAMD study apply to the majority of the Defence Programs and not just to IAMD. So, before recommending an approach to Australia’s IAMD Program, we will first address what are the lessons for overall Program-level capability design from this study. In particular, is the Defence Program structure suitable for integrated force design by individual Programs?

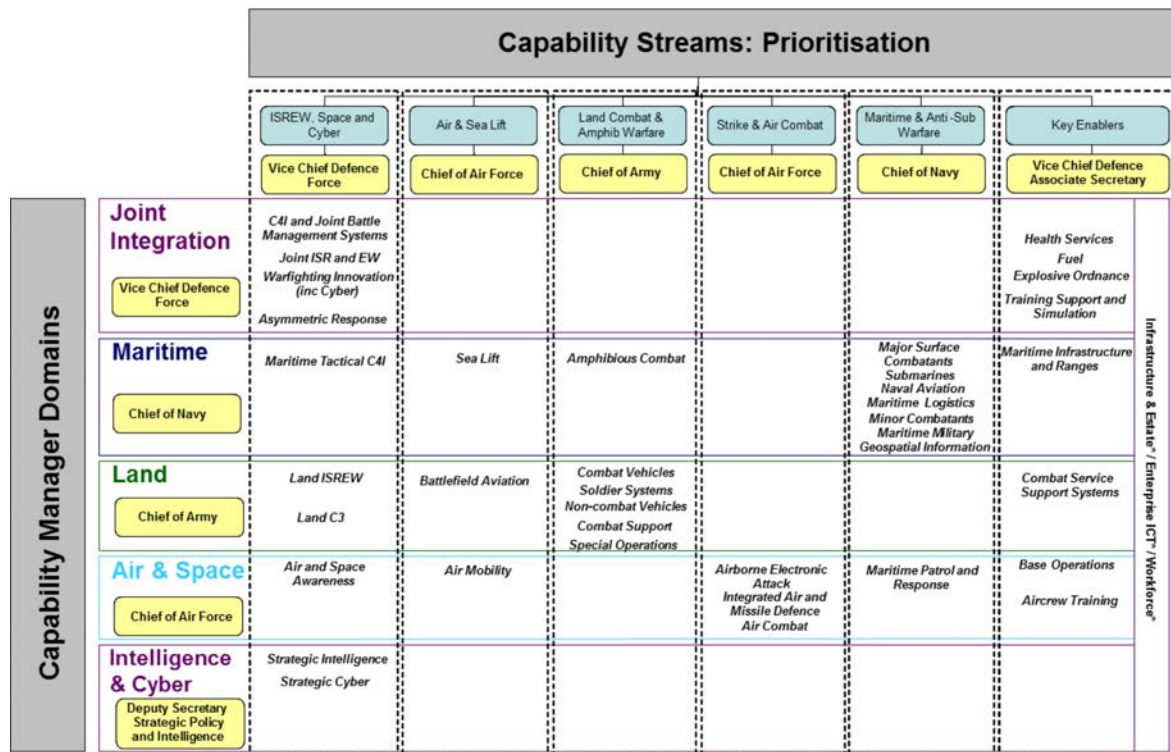
Most, if not all, of the issues and questions that arose in the IAMD study apply to the majority of the Defence Programs and not just to IAMD.

WHAT ARE THE LESSONS FOR PROGRAM-LEVEL CAPABILITY DESIGN?

There are 40 Programs listed in the Defence Program structure that was developed under the First Principles Review (FPR). Thirty seven of the Programs are allocated across a matrix of Capability Streams and Capability Manager Domains, as illustrated on the next page. The Program terminology gets somewhat confusing when you realise that the DIIP also refers to more than 200 “Programs” in the tables of key investment decisions, the majority of which are, in fact, Projects.

An IAMD Program is certainly a useful construct to discuss how a group of Projects, integrated by a common design, could address a growing air and missile threat and, therefore, it would be valuable for Government to understand how component Projects will integrate to address a security need or a capability vulnerability. An IAMD Program would also be of assistance in over-sighting a group of Projects that are in the acquisition process, to ensure that they remain integrated. However, it is difficult to see how an IAMD Program can be designed *by itself* without concurrently considering the C4ISR design aspects of the ISREW, Space and Cyber Stream Programs and, from the Platform component, the design aspects of the Land Combat & Amphibious Warfare, Strike and Air Combat, and Maritime Warfare Stream Programs.

Program Structure



The reality is that an IAMD Program incorporates component capabilities of many other Programs.

Consideration of the weapons component of an IAMD Program would also be a challenge given that the only weapons-specific Program is “Explosive Ordnance,” which appears to have a logistics focus, with the majority of weapons systems spread amongst the other Programs, as a part of integrated capabilities.

This discussion of the Program design challenge points towards an ‘Integrated by design’ theme. This theme has been explored in the RAAF’s Plan Jericho as a means of thinking beyond component capabilities and results in the Jericho meme where “top-down design meets bottom-up innovation.” This meme is aspirational as capability development has, in reality, been “bottom-up design results in the *need* for top-down innovation” where we have had to rely on after-market integration to achieve the required capability. Complicating this issue even further is that the 40 Programs have been allocated to multiple leads and the linkages between the Programs do not appear to have been well defined, other than their relative position on a matrix. The IAMD Program is under the Strike and Air Combat Capability Stream, and under the leadership of the Chief of Air Force; is that the appropriate location for the IAMD Program?

Trying to “design” 40 highly interlinked and inter-dependent Programs separately would seem to be an impossible task. To achieve an integrated force *by design*, you need an integrated Program structure. In fact there is one, *if it is used*.

To achieve an integrated force *by design*, you need an integrated Program structure ... In fact there is one, *if it is used*.

The DIIP states “... the six capability Streams in the framework that are used in the Integrated Investment Program to better represent the key force elements – how they are typically employed and their planned enhancements. This was a deliberate move away from describing our capability investment plans in a stove-piped structure.”²¹

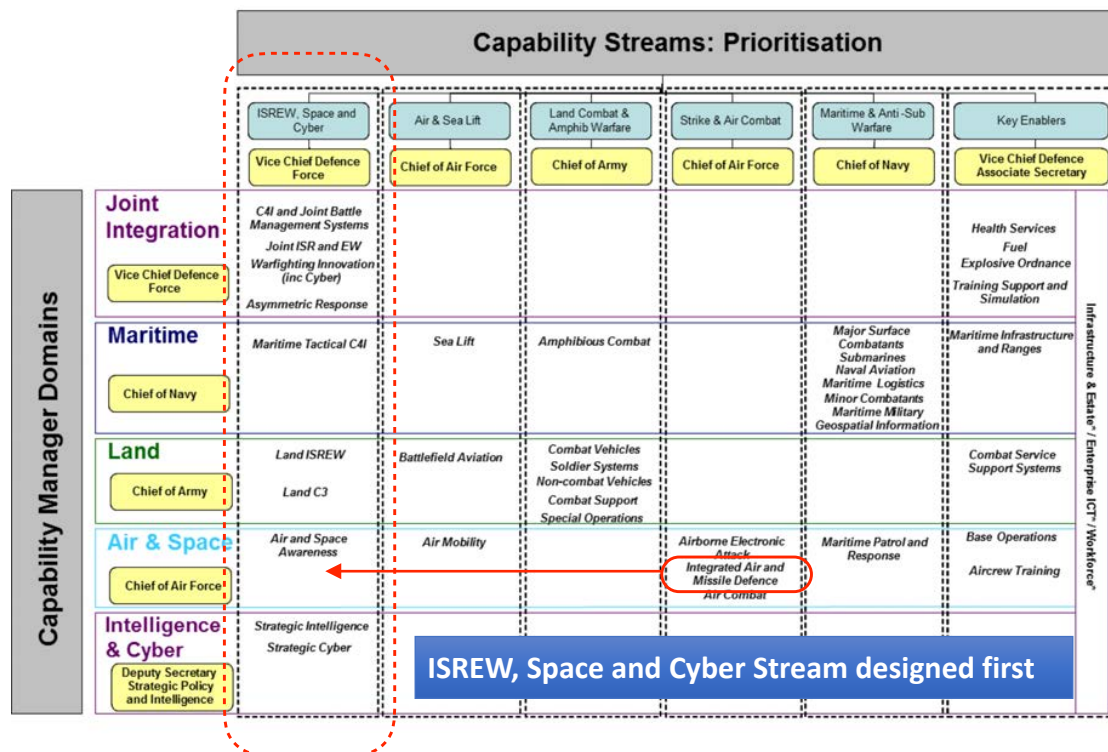
It would therefore seem sensible not to try to start Program-level *design* by individual Programs but rather by Streams with each Program then integrating the detailed Stream design attributes where appropriate; i.e. the Stream design must be undertaken prior to the individual Program design. This approach would reduce the integrated design start point to 6 Streams vice 40 Programs. If we are to achieve an integrated force, we need to stop “driving” Programs as if they were Projects. They are different beasts.

If we are to achieve an integrated force, we need to stop “driving” Programs as if they were Projects. They are different beasts.

Defence could commence the design of the integrated force at the Stream level first, then the design attributes for each Stream could be applied to individual Programs where appropriate. A possible path ahead for IAMD design, for example, could be to prototype the design of the ISREW, Space and Cyber Stream by collectively analysing all of that Stream’s Programs, *along with the IAMD Program*, in order to derive integrated design attributes. Why include the IAMD Program? Because C4ISR is the “glue” of an IAMD capability and that should be the starting point for an IAMD design. It is this latter point that leads to the conclusion that the positioning of the IAMD Program under the Strike and Air Combat Capability Stream is not optimal. The diagram on the next page suggests a shift in the IAMD Program to the ISREW, Space and Cyber Stream to support the start of the Stream design approach.

²¹ Department of Defence, *2016 Integrated Investment Program* (Canberra: Commonwealth of Australia, 2016), Page 13.

Proposed Program Structure

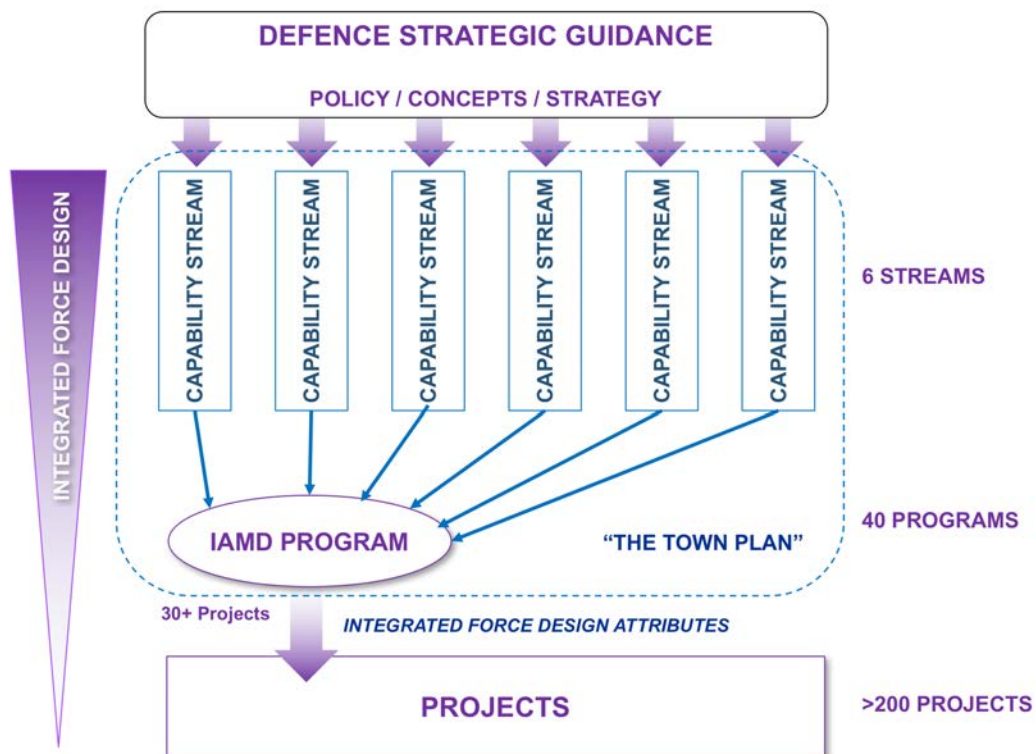


An example Stream design attribute would be that of OSA. It would be pointless to specify an approach for OSA for just one Program; it surely makes sense to apply such an approach across all relevant Programs and in turn their component Projects.²²

What could CAF's "town plan" look like in this case? A real world town plan can consist of multiple layers as discussed previously. If you build a "street", you need to comply with the design requirements for these layers.

A Defence Capability town plan could comprise six layers as illustrated on the next page. Taking into account the plethora of Defence Strategic guidance, the *integrated design* function takes place in the six Capability Streams *first*. The IAMD Program, in this case, acts as the lens that focusses the design attributes from the relevant Streams onto the IAMD Projects and maps out the IAMD Program Roadmap. The Projects then ensure that the design attributes are incorporated in the Project requirements and if they cannot, the Defence Investment Committee is advised so that the appropriate risk assessment can be made and the Project directed accordingly.

²² One of the issues is that the US has two different, concurrent, paths of development for OSA: FACE and OMS. To an extent, Defence needs to make a value judgement on which direction to focus whilst keeping its options open to change direction. A Centre of Excellence could be an option to progress organic understanding of OSA core to future systems development.



What difference could this make, or is this just another Defence process change? If you put yourself in the position of an IAMD Project Manager, they currently have no integrated Program-level design. They have to read and then interpret a large amount of detailed strategic guidance in order to develop Project requirements. Trade-offs that have to be made at the Project level, usually to narrow the scope of the Project to meet schedule and budget directives, are done without an integrated design and without a clear understanding of the consequences of decisions on force integration. This process can result in increased operational risk for the future ADF. A different approach is needed to get onto the path to an integrated force; starting the design process with six elements is a more comprehensible and thus achievable task, than starting the design with 40 elements.

Who can perform this design function? It requires particular skills, experience and cognitive ability. It is evident in discussion with Defence that there are insufficient people with these attributes to have *separate* design teams in each of the Capability Manager Domains. Frankly, the Capability Managers have very high workloads in their raise, train and sustain roles as well as with Project design and transition, without having to individually take on the new distributed Program-level design responsibilities that are in many cases much broader than their own Domains. There needs to be an integrated team that performs this function; however, if this cannot be resourced then a top-down design will remain an unfulfilled aspiration and our Defence Forces will incur unnecessary operational risk in the future.

A possible solution arises when we look at how the ADF fights. We plan and fight as an integrated team under Commander Joint Operations (CJOPS), without CJOPS having to “own” all of the people who are force assigned to an operation. Perhaps we could achieve an integrated force design using the same model; i.e. an integrated cross-capability team

who work cooperatively under the leadership of the Vice Chief of the Defence Force (VCDF) Group to incrementally design the integrated force without having to be posted to the Group full time.

It is also evident that industry will need to be closely involved in this integrated design function. Significant strides have been taken over the past two years with the partnership model between Defence and Industry; the Plan Jericho Program of Work is a good example of this change. However, further development of this partnership model will be necessary if Defence is to be able to develop a realistic and feasible integrated force design as, particularly in the case of IAMD, US Industry is at the forefront of IAMD systems design. This expertise does not, as yet, exist in Australia.

Having discussed the issue of Program-level Integrated Force Design, we turn to the specific issue of the IAMD Program. Earlier in this report the recommendation was made that an IAMD Program-level design needs to be developed as a matter of priority in order to provide a top-down, integrated design across all IAMD component and related Projects and that this implies, *at first glance*, the development of an IAMD narrative, CONOPS guidance, and architectures. Having discussed the challenges of Program-level integrated force design it is evident that the IAMD Program design cannot be initiated at the Program level and it should be guided by initial integrated force design at the Capability Stream level.

A suggested priority is to prototype the design of the ISREW, Space and Cyber Stream by collectively analysing all of that Stream's Programs, *along with the IAMD Program*, in order to derive integrated design attributes. If this approach is successful, a similar approach could be used for the remaining five Streams.

Following the development of the Stream-level designs, the IAMD Program design can be undertaken to focus the Stream design attributes onto the IAMD related Projects and to produce an IAMD Narrative, CONOPS guidance, Architectures and a Roadmap directive.

The design of an IAMD Program should be guided by integrated force design at the Capability Stream level; the priority should be to prototype the design of the ISREW, Space and Cyber Stream by collectively analysing all of that Stream's Programs, *along with the IAMD Program*, in order to derive common design attributes.

CONCLUSIONS AND RECOMMENDATIONS

IAMD is a complex issue. Building a shared understanding of what IAMD is, the threats we will face in the future and how we, together with our allies, will need to operate to address that threat is the first step in understanding what we must *do* to address what is assessed as a growing threat.

The 2016 DWP recognised the air and missile threat to deployed forces and the likelihood that it will increase in the years ahead. The DIIP listed an IAMD Program to be delivered in the period 2018-2030 with some \$2-\$3B allocated. Whilst there is a budgeted IAMD Program identified with component capabilities listed in the DIIP, it is a list of funded equipment and systems and not a narrative or "vision" of what IAMD is and how we will

operate to address the threat. We need an IAMD narrative or vision to provide the context of, and focus for, our IAMD Program.

The 2013 United States Joint Vision 2020 for IAMD notes that at its core, IAMD is the integration of offensive and defensive operations against air-breathing and missile threats, meant to counter an enemy's ability to degrade or disrupt our operations and projection of combat power in a contested environment. The IAMD Vision emphasises that if deterrence fails, neutralising an adversary's offensive air and missile assets prior to use continues to be the preferred method to negate them and, with the current and projected growth in threats, is the only practical means to defeat large threat inventories. This link between offensive and defensive operations for IAMD is critical; Left of Launch is not optional, without it we will leave our forces exposed in future regional operations.

The US framework is impressive and yet it is facing significant challenges in execution; a growing debate in the United States is the issue of how to develop a robust yet affordable IAMD system. Recognising these challenges is important for Australia as we begin our IAMD journey with far fewer resources than are being applied to the challenge in the US.

US commentators have stated that success in addressing the growing IAMD threat will take no less than a bold, holistic reimagining of America's IAMD. The gap between the threat and the ADF's IAMD capability is growing and is likely to be larger in a decade than it is now, despite the significant level of investment the Government has committed to in the DIIP.

Simply executing the DIIP, as listed, will not suffice if the Australian Governments of the next decade wish to have the option of deploying forces into the Indo-Pacific region; we will need to approach the challenge somewhat differently than we have done to date. This will necessitate revised thinking around concepts of operation, integrated design, acquisition, sustainment, processes and people.

This report summarises *some* of the "lessons" gleaned from the US IAMD experience and suggests what approaches could be adopted by Australia. The critical issues are that an IAMD Program cannot be built purely bottom-up if it is to be both effective and affordable; a top-down direction and focus is essential. There is a need for a Directive, such as an IAMD Roadmap, that is an integrated direction vice a recommendation. Without such a Directive, capabilities can and will be built in a stove-piped, bottom-up approach.

There are clear leaders in the US in terms of IAMD systems thinking that can provide a path for Australia to follow. Such Programs could form the basis of an integrated capability to meet Australia's requirements if we are prepared to accept a degree of developmental risk, albeit much lower than if we were leading the development ourselves. The alternative is acquiring current technology IAMD components that are not suitable for the future threat environment resulting in greater operational risk for the future force as we try to integrate those components in an after-market manner.

The first IAMD related Projects to be considered under the new DIIP, AIR 6500 and Land 19 Phase7B, are closely coordinated and are focussed on the integrated outcome of the Projects. The approach being adopted for the initial IAMD Projects is laudable; however, Defence is yet to define an IAMD Program-level design that addresses the complexity of IAMD as a "System of Systems," as has been done in the US. A top-down approach will afford the opportunity to maximise our IAMD capability and address the growing threat-capability gap.

At first glance, it seems obvious that an IAMD Program design should be developed as a matter of priority. However, it is difficult to see how an IAMD Program can be designed *by itself* without concurrently considering many of the other 39 Programs in the new Defence Program Structure; the reality is that an IAMD Program incorporates component capabilities of many other Programs. Trying to “design” 40 highly interlinked and inter-dependent Programs separately would seem to be an impossible task. The conclusion reached is that the integrated design of the future Defence force needs to start at the Capability Stream level. Once that work is done, subordinate Program designs can be developed. There needs to be an integrated team that performs this function; however, if this cannot be resourced then a top-down design will remain an unfulfilled aspiration.

The following recommendations are made.

- Defence should commence the design of the integrated force at the Stream-level first. The design attributes for each Stream could then be applied to individual Programs where appropriate. The priority should be to prototype the design of the ISREW, Space and Cyber Stream by collectively analysing all of that Stream’s Programs, *along with the IAMD Program*, in order to derive common design attributes.
- The design of an IAMD Program should be a priority and should be guided by integrated force design at the Capability Stream level. The IAMD Program would act as the lens that focusses the design attributes from the relevant Streams onto the IAMD Projects and maps out the IAMD Program Roadmap. The IAMD Program Roadmap needs to be a Directive rather than just a recommendation; an IAMD Program cannot be built purely bottom-up by Projects if it is to be both effective and affordable; a top-down direction and focus is essential.
- The IAMD Program needs to identify the Strategy and Roadmap for IAMD and address issues such as who we follow and what level of acquisition risk is appropriate given the operational risks we may face in the future. Such a roadmap should identify initial Project steps and how we will eventually integrate with the future US IAMD Program.
- The Program design function needs to catch up with Projects underway and not impede them.

A FINAL THOUGHT

The discussion of the challenges Defence faces in Integrated Force Design, and the IAMD Program in particular, provided the opportunity to postulate what Defence should do differently in order to design and build the integrated force. The following “integrated force hypotheses” were developed by the Williams Foundation to be tested at the Integrated Force Seminar to be held in April 2017.

- We must operate as an integrated team from the design, through delivery to the operation of the force; failure to act as such will incur unacceptable risk in future operations.
- If we don’t ‘design’ the integrated force we are committed to “after-market” integration.
- We can’t build and operate an integrated force using business models developed for acquiring stand-alone, stove-piped capabilities.
- ‘Design’ is about more than just platforms and systems - it is also about how we acquire, operate and sustain an integrated force in a more complex interconnected global context.
- If we over-complicate the ‘design’ process we will stall our efforts and get the same results we have had over the past 20 years – stove-piped capabilities.
- We must, however, recognise that the task load of the three Services in their Raise, Train, Sustain and Capability Manager roles means that simply delivering a large volume of force design guidance to the three Services will not work.
- Cultural change, as reflected in CAF’s strategic plan narrative, is required to prioritise the integrated force outcomes over the individual force priorities where appropriate.

The reader may care to reflect on these hypotheses in light of the Report’s findings.

MAJOR SPONSOR PROFILES

Lockheed Martin - For Security, For Industry, For Australia

Lockheed Martin is a global leader in defence engaged in the research, design, development, integration and sustainment of advanced technology systems. The company has had a presence in Australia for over 70 years, currently employing over 730 people in all states and territories.

Lockheed Martin Rotary and Mission Systems (RMS) provides systems engineering, software development, training solutions and complex program management for global security and civil and commercial markets. RMS draws upon its core capabilities in advanced platforms and weapons, C4ISR, global sustainment, training and sensors and its strong legacy in developing integrated systems that link air, land, maritime, space and cyber domains to support the Australian Defence Force.

Our experience with programs such as the F-35 Joint Strike Fighter; the Command, Control, Battle Management and Communications (C2BMC) system and the Aegis combat system, allied with our extensive knowledge of open system architectures, model-based engineering, agile development processes and cross domain solutions will be leveraged to support the development of an Australian Integrated Air and Missile Defence capability, and with force transformation and the realization of 5th Generation capabilities in Australia.

Lockheed Martin stands ready to assist the Australian Defence Force with realizing its vision for the future.

Northrop Grumman

Northrop Grumman recognises the power of maximising advantages offered by our modern weapons and systems through transformation. In today's complex and dynamic environment, transformational efforts aim to eliminate incompatible proprietary systems, streamline operations, minimise maintenance costs and secure network vulnerabilities while deploying greater capabilities.

Decision superiority in the contested, information-centric operating environments of the future requires the integration of fifth-generation air platforms into the joint force. By leveraging the advanced sensor, data fusion and communications technologies available to fifth-generation airborne platforms, a networked, fifth-generation joint force will deliver optimised power in all operating environments – space, air, land, maritime, electromagnetic and cyber.

As a pioneer of open architecture integration and industry leader of fifth-generation C4ISR systems, Northrop Grumman designs its systems with better, faster, more precise decisions as priority. By truly networking sensors, weapon systems and command-and-control, our systems dramatically improve situational awareness and enable rapid, accurate decision making. Our extensive experience developing and fielding these advanced systems in complex environments provides a solid foundation to meet the challenges of joint and coalition integration in the contested, resource-limited operational environments that will likely characterise future warfare.

Northrop Grumman is a leading global security company providing innovative systems, products and solutions in autonomous systems, cyber, C4ISR, strike, and logistics and modernization to customers worldwide. Please visit news.northropgrumman.com and follow us on Twitter, [@NGCNews](https://twitter.com/NGCNews), for more information.