Nova Systems

Discussion Paper
AUKUS Pillar II

September 2024

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Executive Summary

AUKUS has changed the Australian defence industry landscape.

The trilateral security partnership transforms the outlook and potential composition of the industrial bases of Australia alongside the United Kingdom and the United States.

While the scale of the Pillar I nuclear-powered submarines has dominated discussion and headlines, Pillar II is the catalyst by which the three nations will forge new collaboration on advanced technology and interoperability; co-producing and co-delivering next-generation warfighting capabilities across eight areas.

Pillar II presents a significant opportunity for Australian companies, as well as challenges. To maximise the potential for Australian industry, there is a clear need for increased dialogue at the national defence planning table through transparent and meaningful engagement.

The focus of Pillar II on advancing development of undersea capabilities, Quantum, Advanced Cyber, Artificial Intelligence and Autonomy, Hypersonic and Counter Hypersonics, and Electronic Warfare represents a vast undertaking.

The clear challenge now shared by Defence and industry is turning the "how" and "when" of Pillar II into a coherent, long-term, actionable roadmap. This includes solving the tri-nation challenge of collaboration without unnecessary duplication. A formalised process is needed for Australian industry and government to partner and have capacity to realistically contribute at the tri-national level.

The purpose of this paper is to consider Australian capabilities that could contribute to the AUKUS alliance, spark conversation about areas that should be prioritised and highlight the how the SDIPs can guide our contribution to AUKUS.

It pays particular focus to the areas of Test & Evaluation (T&E), Certification and Systems Assurance, Digital Engineering and autonomous systems. Advancing these capabilities will be critical to being able to deliver AUKUS Pillar II vision and ambitions.

It takes into consideration the recommendations of the;

- Defence Strategic Review,
- National Defence Strategy 2024,
- Defence Industrial Development Strategy (DIDS),
- Sovereign Defence Industrial Priorities (SDIPs),
- Integrated Investment Plan
- Defence T&E Strategy, and
- Digital Engineering Strategy.

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Introduction

What will Australia contribute to AUKUS Pillar II? And moreover, what could a truly integrated partnership between Defence and industry contribute?

AUKUS requires a full pivot where Australian industry must think, act, integrate, invest and deliver on tri-nation terms as a first principle.

The challenges of this shift are recognised at a high level by the new Defence Industry Development Strategy (DIDS). This is one step in what will be a challenging journey.

We need to ensure that the defence industrial bases of each partner carry their part of the load to avoid duplication and maximise cooperation. To achieve this, the AUKUS framework needs an industrial roadmap between the partner nations with a level of granularity far deeper than is currently available.

Nova Systems recognises that AUKUS is not a single opportunity and has no single approach, rather it is a vast and multifaceted ecosystem.

This year's Defence budget included an additional $1 billion over the next four years to accelerate Australian Defence Force (ADF) preparedness including long-range strike, targeting and autonomous systems.

The Government has released various recent strategy papers which provide a road map for Australian defence industry including outlining the seven Sovereign Defence Industrial Priorities (SDIPs) as part of the DIDS.

Three key priority areas for Nova Systems,
an Australian owned and controlled company

Autonomous Systems

Digital Mission Engineering

Test & Evaluation, Certification and Systems Assurance (T&ECSA)

SDIP 7 identifies a long list of capability needs for Defence in the area of T&ECSA – all of which Nova has experience in delivering as a trusted partner of Defence.

SDIP 5 covers autonomous systems. Digital Engineering is inextricably linked across both SDIPs with requirements for synthetic environments, modelling and simulation and digital twins. What is being called for is "interchangeability" of platforms, as well as "interoperability". With Australia buying new platforms, and particularly those bought off the shelf with a view of speed to introduction into service, interchangeability and interoperability needs to be addressed by Digital Mission Engineering.

These capabilities run across multiple facets of the eight AUKUS Pillar II priorities and advancing them is critical to delivering the AUKUS vision.

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Test & Evaluation (T&E), Certification and Systems Assurance

The Government released its Defence Industrial Development Strategy (DIDS) and accompanying Sovereign Defence Industrial Priorities (SDIPs) in February 2024 highlighting what the Commonwealth wants from industry.

Test & Evaluation, Certification and Systems Assurance (T&ECSA) was recognised in the DIDS as one of the SDIPs – and is arguably one of the most important.

Test and Evaluation (T&E), as a fundamental element of T&ECSA, plays a critical role across all elements of the capability life cycle and runs across all other SDIPs – it is key for managing capability risk for Defence. As stated in SDIP 7: "Its role is to assure that capabilities are safe and operationally viable through the provision of objective evidence to quantify the risk of new technologies, concepts or capabilities on warfighting operations."

Achieving "minimum viable capability" on time requires sufficient T&E, particularly a focus on testing early during the development process to identify and mitigate any deficiencies before they manifest themselves in capability shortfall. This will only become more important under the AUKUS agreement as we buy more capabilities from our partners.

The Defence Strategic Review highlighted the need to rapidly deliver **integrated joint force capabilities.** Developed over multiple decades, Australia's Defence T&E capability has historically been focused on the individual project and platform level. This has restricted the potential to address fundamental issues of capacity and resilience, including workforce, facilities and technology. Additionally, it has limited options for continuous improvement of Defence T&E to ensure currency with new and emerging systems and solutions. To its credit, Defence has recognised and made efforts to rectify this through their Defence T&E Strategy which industry supports and stands ready to help implement.

Investment in modelling and simulation is key for effective force-level, integrated systems-of-systems testing, and to allow validation activities in a Live, Virtual and Constructive (LVC) environment. These are additional requirements identified in SDIP 7. While synthetic testing and digital twinning are important and evolving aspects of digital engineering capability, the digitisation of the overall systems engineering lifecycle through implementation of Model-Based Systems Engineering (MBSE) is equally as important. This provides a systems assurance digital thread, and therefore seamlessly integrates the capability definition, certification, and through-life sustainment phases of capability projects.

> For decades, Nova has been playing in the real-world traditional T&ECSA space, while upgrading our services to innovate and meld this with modern T&E applications and digital engineering techniques, such as digital synthetic modelling and MBSE, and doing it with speed and at scale.

SDIP 7 calls for an active investment in T&ECSA from Australian industry to support the rapid evolution of the broader Defence T&E Enterprise, enabling joint force assurance, T&E in synthetic environments, digital twin development, and assurance of contemporary complex systems incorporating Robotics, Autonomous Systems, and Artificial Intelligence (RASAI).

Furthermore, SDIP 7 recognises the vital role industry must play in training and mentoring the sovereign T&E workforce to address an identified shortfall of skilled T&E practitioners of over 400 T&E practitioners in 2024, growing to over 1,000 by 2030. Nova is mitigating this by supporting additional training capacity to allow industry to train and mentor their own workforce to increase the overall number of skilled T&E practitioners and helping to ensure the full spectrum of required T&E and Digital Engineering skills are adequately represented.

*Appendix 1 outlines Nova Systems response to SDIP 7.

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Autonomous Systems

In the evolving landscape of modern warfare, the integration of autonomous and uncrewed systems into the Australian Defence Force's arsenal is not just a strategic option, but an imperative decision for future readiness. Conflicts in regions like Ukraine and Gaza serve as poignant reminders.

Autonomous systems offer Defence the opportunity to generate affordable mass, increase range and lethality and increase force protection.

The DIDS and Defence Strategic Review highlighted the criticality of undersea warfare capabilities (crewed and uncrewed) optimised for persistent, long-range sub-surface intelligence, surveillance and reconnaissance, and strike. It also highlighted the need for Air Force to maintain both crewed and autonomous systems capable of air defence.

These systems promise unparalleled capabilities, yet their adoption brings a spectrum of novel challenges and questions for capability developers. How do we select the best in breed system, in the face of rapidly evolving tactics and countermeasures? How can they be safely and effectively integrated for use in collaboration with crewed systems? How much systems assurance rigour is enough for a minimum viable capability?

The AUKUS Pillar II focus on advanced capabilities such as underwater autonomous vehicles, artificial intelligence and the integration of commercial technology to solve warfighting needs, make this a shared challenge across the partner nations.

The need to test and assure such advanced capabilities is driving the uptake of synthetic methods such as Digital Mission Engineering and the requisite investment by Australian industry.

SDIP 5 (Development and Integration of Autonomous Systems) recognises the need for complimentary industry capability in digital engineering, modelling, and simulation to enable development of T&E, and certification of asymmetric autonomous system capabilities for Defence.

Nova Systems is actively involved in the development and testing of autonomous systems, providing a range of capabilities including;

- Concept Development
- Testing
- Design
- Implementation
- Safety
- Lifecycle support for remote and autonomous systems
- Integration

In addition, Nova Systems is delivering an advanced T&E practitioner course which includes training in methodologies for validation of complex systems containing autonomy, AI and Machine Learning.

Included is hands-on training on test techniques on Autonomous Underwater Vehicles (AUVs), delivered in collaboration with the Australian Maritime College, aiming to equip professionals with the skills needed to test and evaluate these complex systems.

Nova Systems has also invested in a fleet of open architecture Uncrewed Aerial Systems (UAS) procured specifically for developing methods for validating the digital mission engineering simulations of systems-of-systems of uncrewed and autonomous systems, building confidence in testing in LVC scenarios.

The capability development includes building the digital engineering threads necessary to create and validate high-fidelity digital twins of uncrewed systems, where test and evaluation data is passed between the physical world and digital environment.

Nova Systems is expanding the playing field increasing the amount of T&E work done in the synthetic world through modelling, simulation and machine learning before final testing in the real world.

This has many advantages including rapid speed to delivery and reduced costs.

While not specifically referenced in SDIP5, another significant consideration in the autonomous systems space is the rapidly growing impact of Small Uncrewed Aerial Systems (sUAS).

Small Uncrewed Aerial Systems (sUAS) are a disruptive threat across the modern battlespace. This challenge is complex, requiring Counter-sUAS (C-sUAS) to keep pace with emerging technologies and respond to rapidly evolving threats across all domains.

Adversaries can deploy sUAS with very little or no warning, and they are capable of operating below the detection threshold of current military early warning systems.

The ADF already faces the challenge of countering sUAS threats across the air, land and maritime environments, with lessons from current conflicts making clear the threat environment will only increase in complexity. The Commonwealth has identified this as a priority outlining plans to invest in deployable counter-small uncrewed aerial systems capabilities in its Integrated Investment Program.

Countering the rapidly evolving technology and increasing levels of automation of sUAS requires a high level of collaboration between Defence and Australian Industry.

Critical to responding to this evolving challenge is adopting a System of Systems (SoS) approach. This approach focuses on managing the interoperability and integration of the C-sUAS with other Defence systems.

The Australian Army Research Centre recently released a paper "Small Aircraft, Sizeable Threats: Preparing Army to Counter Small Uncrewed Aerial Systems" by Dr Carl Rhodes. Its recommendations include a training program for all Army personnel around the sUAS threat, along with methods to counter those systems. The second is investing in a layered approach in its efforts to detect and effect sUAS, and third to establish C-UAS centre of excellence focused on technology forecasting, gathering global lessons.

05

Digital Mission Engineering

Digital Mission Engineering (DME), along with modelling and simulation, plays a pivotal role in unlocking the true potential of autonomous systems by providing a comprehensive understanding of their capabilities, limitations, and operational effectiveness.

DME is the process of digitally modelling a system (or system of systems) as it will operate in its expected conditions, including with or against other platforms and systems.

In other words, it can simulate missions and optimise them digitally before a client ever has to take the system out of the box or shed.

Modelling and simulation capabilities allow experimentation that couldn't happen in a real-life test scenario to discover meaningful relationships between mission inputs and mission outputs.

While it's not necessarily a new concept, the relationship between T&E and mission simulation is becoming increasingly significant. In contemporary thinking and practice in the United States, T&E is becoming less about individual system capability, and is now being applied in parallel with modelling and simulation techniques for predicting and planning mission capabilities comprising complex systems of systems.

What Nova is doing is applying a model-based approach to capability development to make sure our clients are selecting systems that will achieve their objectives.

This allows the clients to understand whether their complex system of systems will be operationally effective, and to minimise their need to test once they have it.

Defence released the Defence Digital Engineering Strategy 2024 which is a necessarily ambitious plan to reap the digital engineering benefits that can only be realised by broad application, integration and data sharing. The next step is a Defence-wide roadmap with digital engineering champions contributing – an area Nova is both championing and supporting.

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Conclusion

The AUKUS vision – and that detailed in recent defence strategy papers and reviews – must ensure that the defence industrial bases of each partner carry their part of the load, facilitating tri-national uplift, avoiding unnecessary duplication and maximising alignment, and assuring sovereign means of supporting and sustaining shared capabilities.

T&ESCA is the lever that will enable Australia to assure ADF capabilities, support accelerated development and fully integrate within the AUKUS framework; independently assess potential AUKUS solutions from Australian industry; and enable genuine multinational technology development between AUKUS partners.

In support of this, Nova is actively investing in next-generation T&E core

Leveraging a combination of digital engineering, model-based systems engineering, Artificial Intelligence , modelling and simulation and specialised new software tools. This extends to advancing our capabilities in autonomous and uncrewed systems. DME toolsets, together with TECSA, will assure digital modelling into service.

No AUKUS partner can afford to separately advance eight different classes of advanced technologies.

Rather, we should have focal areas of responsibility including supporting enabling capabilities like those mentioned, allowing faster and more efficient capability development, bringing forward tangible contributions to the partnership without duplication and at speed. The seven SDIPs should guide Australia's contribution to AUKUS Pillar II – detailing the priority capabilities the nation determines to be a truly sovereign requirement.

This approach would also assist in resolving workforce challenges across all three partners.

07

Appendix 1 – Nova Systems response to SDIP 7

SDIP 7 recognises the critical role of T&E across all elements of the capability life cycle.

It states Australian industry plays a vital role in ensuring the Australian Defence T&E Enterprise workforce and infrastructure are sufficient and relevant to the technologies and products they deliver.

T&E is Nova Systems core offering.

It is what the company was founded on two decades ago and we have been actively investing in this capability uplift through our T&E Centre of Excellence, advanced technologies, digital methods and world-leading training.

Requirements	Nova Systems Capability
T&E Training	✓
Instrumentation and systems	✓
Synthetic environments	✓
T&E Centres of Excellence	✓
Enhanced synthetic T&E environments	✓
Physical T&E infrastructure remediation	✓

7.1 T&E training and skilled T&E workforce

SDIP 7 recognises the vital role industry must play in training and mentoring the sovereign T&E workforce to address an identified shortfall of skilled T&E practitioners of over 400 T&E practitioners in 2024, growing to over 1,000 by 2030. Nova Systems has been investing in advanced training for decades and ensuring the skills of the future T&E practitioner evolve in lockstep with advanced technologies. Nova Systems' world-leading T&E Advanced Course is the jewel in the crown of its training offerings.

Nova Systems has invested in training development, course piloting and roll-out of advanced T&E practitioner training designed to satisfy the Senior T&E practitioner competencies detailed in the ADF Defence T&E Competency Framework for T&E workforce of 2011, and the competencies identified by the International Test & Evaluation Association (ITEA). This training is contextualised for:

- The design of experiments for systems-of-systems T&E, including at the joint force level, this includes experimental design in both the physical domain and simulation domain.
- T&E of uncrewed and autonomous systems, including autonomous underwater vehicles and uncrewed aerial systems
- T&E of machine learning algorithms, including target classification deep learning algorithms and computer visions systems.
- Synthetic (digital) T&E methods with an emphasis on T&E techniques required to validate modelling and simulation outputs.
- Digital Misson engineering and link between T&E and mission engineering.
- Complex test planning, execution, and management.

In 2022, Nova established the T&E Centre of Excellence (CoE). Now in its third year, under the CoE banner Nova has performed more than 8,000 hours of T&E capability development and T&E training and practitioner development. This has been performed by 27 Australian junior and senior T&E professionals in the fields of:

- Digital Environments, tools, and technology stack digital threading; digital mission engineering and modelling and simulation
- Machine Learning & AI
- Underwater Autonomy
- Uncrewed Aerial Systems
- Synthetic Environments
- Systems of Systems
- Joint Force Assurance

In addition, Nova has funded and delivered an internal digital engineering literacy program that upskilled over 300 professionals in model-based systems engineering.

Nova has invested in training our T&E practitioners in both the classical T&E skills and modern scientific methods necessary to test AI enabled autonomous systems. We have trained ADF personnel from VCDF Group and the Maritime Warfare Centre in these methods. We have developed and field-tested our own automatic target detection AI algorithms and trained Commonwealth personnel on their use.

7.2 T&E Centre of Excellence

In 2022, Nova established the T&E Centre of Excellence (CoE) to enhance collaboration between industry, Defence and academia on Australian defence capability, digital technologies, industry training and commercialisation of cutting-edge research, digital technologies, training and ideas.

Two key focus areas of the Centre of Excellence are future workforce skilling and the impact of evolving capability assurance approaches. Since its inception, there has been ongoing investment in advanced capabilities and training, with a specific focus on Digital Mission Engineering.

Supporting this is the contractual relationships with leading Australian universities which bridge the gap between industry and academia in the fields of systems-of-systems experimentation, artificial intelligence and machine learning, underwater autonomy, and systems engineering. The Nova Systems Test & Evaluation Centre of Excellence has entered into contracts with the following prominent Australian universities:

- Uni of Tasmania (Australian Maritime College) for T&E capability development, T&E practitioner training and underwater test range access in the field of autonomous underwater vehicle and underwater AI testing.
- University of Adelaide for T&E practitioner training development and delivery in the field of Machine Learning performance assessment and emerging T&E methods.
- University of South Australia, through Defence SA, to support PHd and research into improved T&E methods for complex systems.
- University of Melbourne for Design of Experiments training development and delivery, contextualised for systems of testing, for senior T&E practitioners.

Other key achievements include:

- Investment in Digital Mission Engineering workforce creation capability. A digital classroom has been delivered in Melbourne with all the necessary hardware, certified instructional staff, and relationships with specialist software suppliers required to build a sustainable workforce of mission engineering specialists and senior T&E practitioners.
- In-depth training needs analysis to determine what skills and knowledge future T&E professionals require in a post digital-engineering revolution world. This study then formed the basis of the new 4-week Advanced Test and Evaluation (T&E) Practitioners Course that has been created to upskill T&E professionals in both industry and Defence.
- Development of methods for characterising the suitability of small commercial drones for missions and for rapidly incorporating digital models of small drones into physics-based digital mission engineering simulations.
- Integration of digital mission engineering, electromagnetic spectrum engineering, and model-based T&E tools to create both a technology stack, and a body of codified knowledge in order to understand how this technology can accelerate capability realisation.

7.3 T&E Infrastructure & synthetic environments

Nova Systems has collaborated with Victorian state government and Latrobe City council to demonstrate that Uncrewed Aerials System (UAS) testing can be conducted in regional Victoria, including using this area to train T&E practitioners. This represents a net increase in UAV testing areas as this space was not previously used for UAs testing. We have also invested in creating mobile UAS testing ground equipment and T&E personnel with the skills to support UAS testing. This UAS T&E capability is also digitally threaded with our synthetic environment meaning that digital mission engineering experiments and mission thread analysis can be validated with real/live flight test activities.

In addition, Nova has built a digital engineering and synthetic T&E classroom equipped with the hardware and software necessary to teach systems–of–systems test design and analysis (design of experiments), digital mission engineering, uncrewed system command and control, Uncrewed system T&E, machine learning algorithm performance assessment / T&E. This classroom has been utilised by Australian Space Command personnel, JCDF T&E personnel, and T&E personnel from RAN Maritime Warfare Centre.

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