UNSW AUSTRALIA
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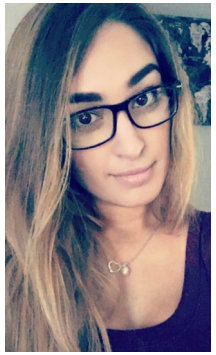
Developing South-East Asian Tensions & Options for Australia's Submarine Program

SubSTEC conference Fremantle 18-22 November 2019

Never Stand Still | Capability Systems Centre

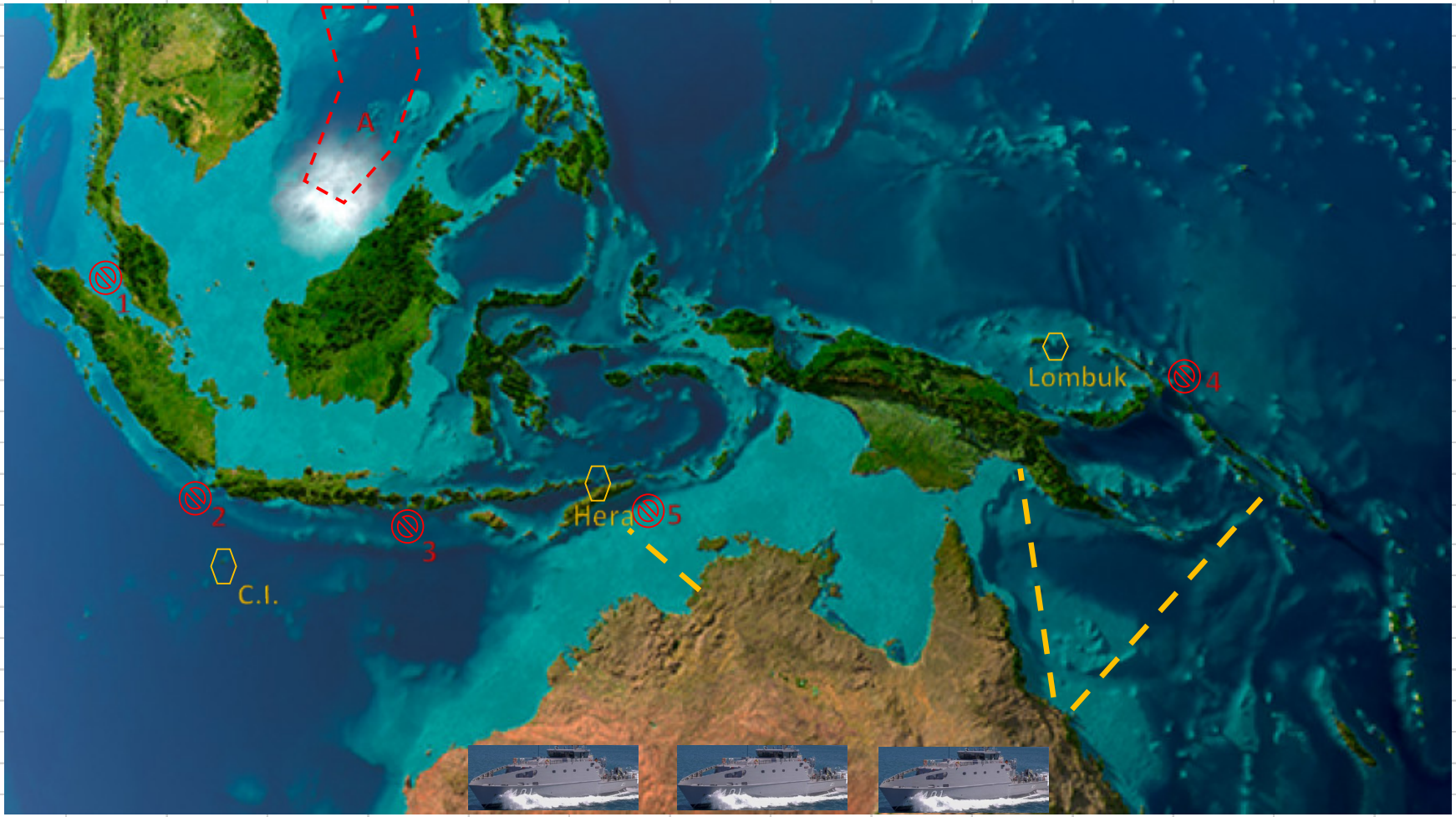

Dr Keith Joiner

- Tensions increasing risk of near-term Asian war
- Radius reduction
- Countering Sea-mining: changing submarine role
- Cyber-resilience: changing submarine defences
- Fixing Fuel Security: improving conflict resilience
- Agile management: changing submarine program culture
- Conclusion

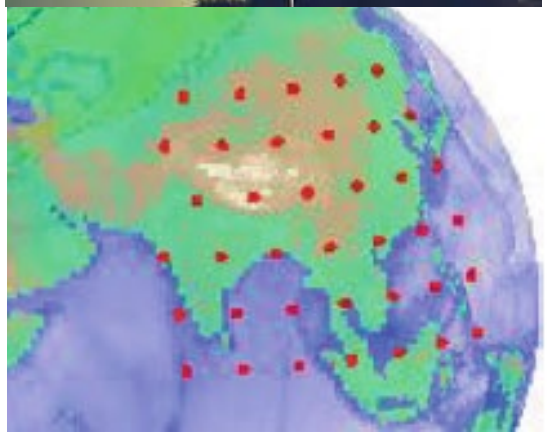


Thanks to co-authors: A/Prof Simon Atkinson, Dr Kaitlynn Castelle & Dr Joe Bradley

ADFA
AUSTRALIAN DEFENCE FORCE ACADEMY



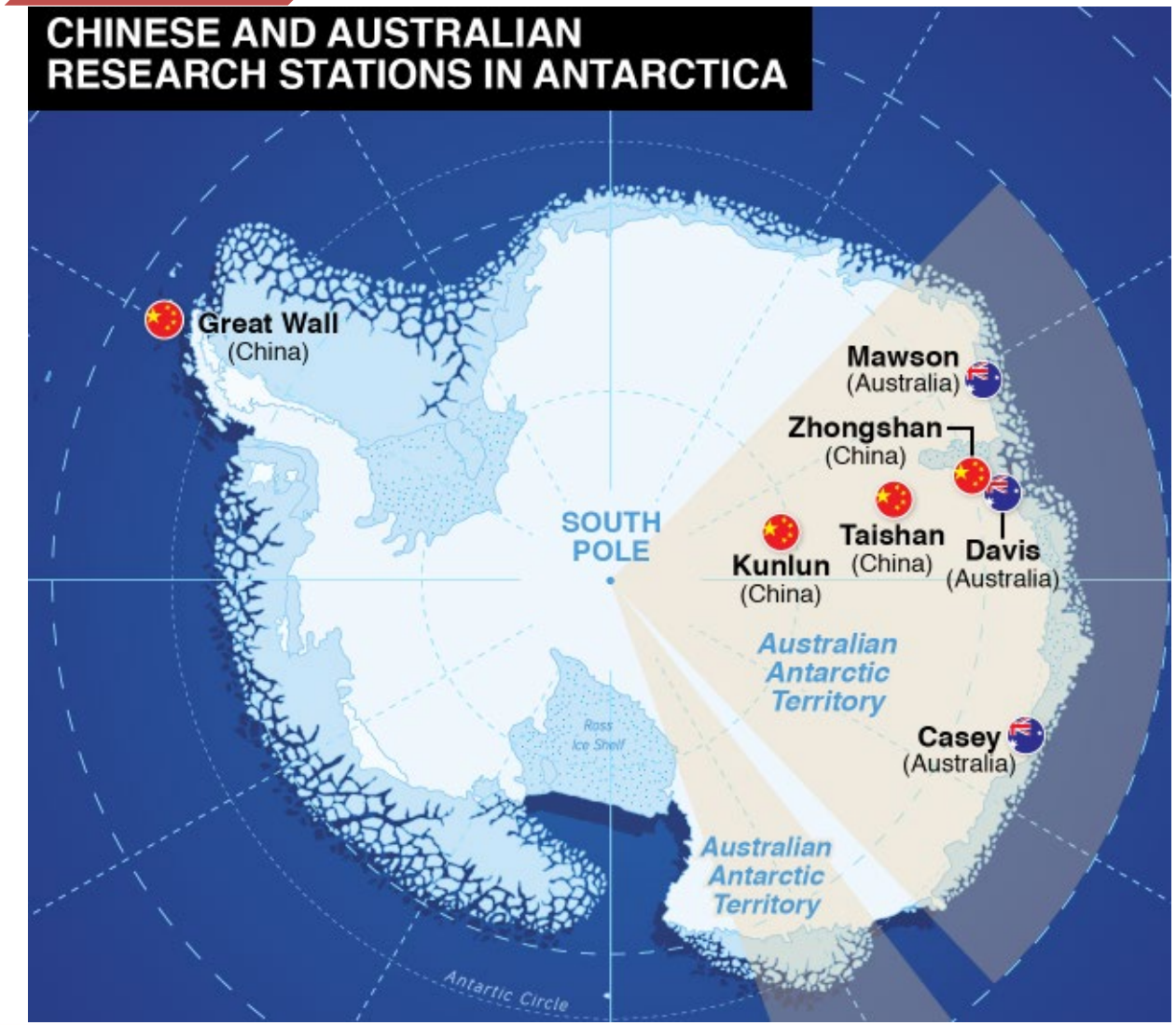
Asian countries are the most prolific in pursuing submarines of any region in the World (Bitzinger, 2016)



R. Shi; L. Liu; T. Long; Y. Wu and G. G. Wang, "Multidisciplinary modeling and surrogate assisted optimization for satellite constellation systems," Structural and Multidisciplinary Optimization, 58(5), pp. 2173-2188, 2018

Anonymous, accessed 9 July 2019 at http://hfasia.blogspot.com/2017/02/pla-oth-sw-radar-network-and-its-300-km.html, 2017.

R. Pickrell, "China says it has developed a new radar system that can spot US stealth fighters at incredible distances," Business Insider Australia, June 12 2019,



News.com.au article, 'As Australia looks north, China's presence in the Antarctic continues to grow', Gavin Fernando, 7 Sep 2018

Changing nature of warfare illustrated by what Australian Defence Minister has described as "*grey zone*" or "*coercive statecraft*" tactics below the threshold of armed conflict:

> *"International law and norms are being ever more brazenly challenged, whether in the Gulf or the South China Sea, in eastern Ukraine or Salisbury. ...More and more frequently, malevolent cyber activity is threatening our security and economic wellbeing, while new technologies are rapidly expanding potential for major disruption. ... It is about understanding how we obtain better cross-government engagement and decision-making to effect solutions in response to challenges as diverse as economic coercion, cyber-attack, information warfare and misuses of soft power."*

This is not just cyber-warfare, but now includes examples of sea-mining of shipping lanes

[J. Walker, "Call for UK to flex muscles in Pacific," The Australian, 8 July 2019

Building blocks so far


(15) 2019-2022

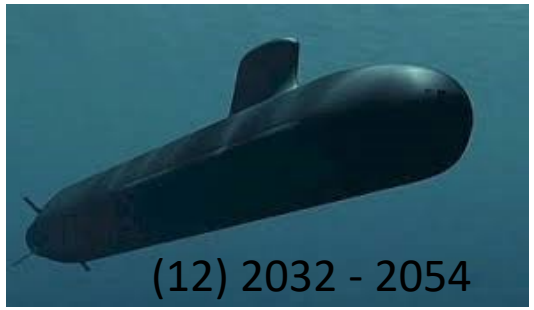

(7) 2021-2026


(3) 2019-2022


(9) 2030 - 2040


(2) 2022 - 24

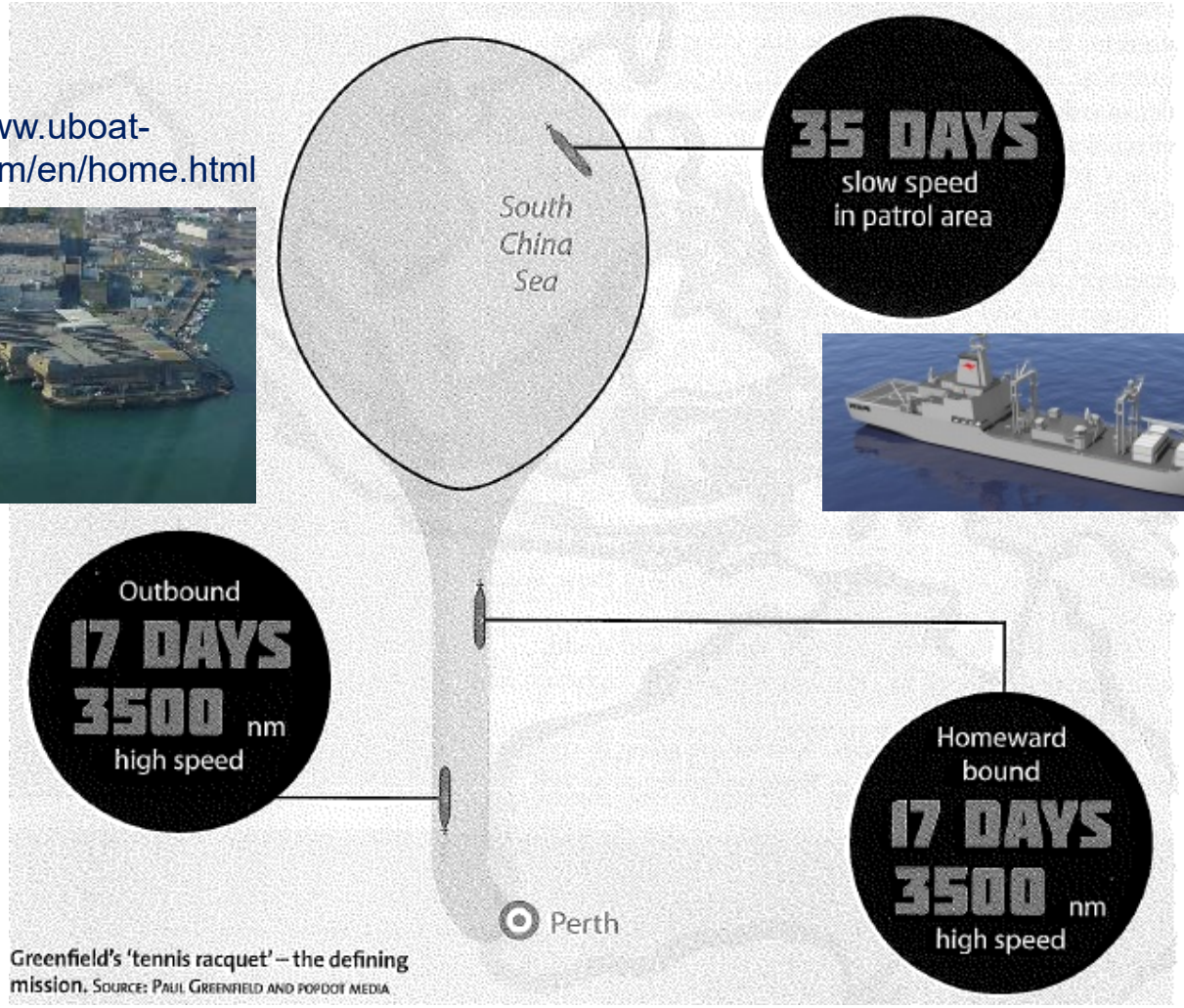

(6) 2040?


(12) 2032 - 2054

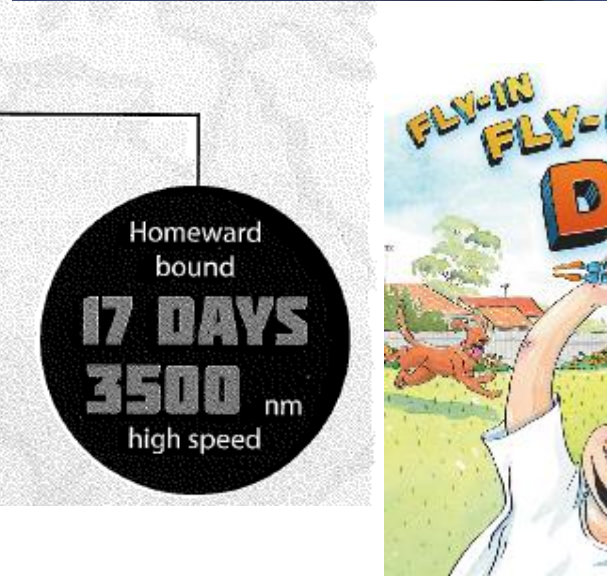

(2) 2024 - 28

Naval Technology: VENARI-85 Mine Warfare and Hydrographic Ship

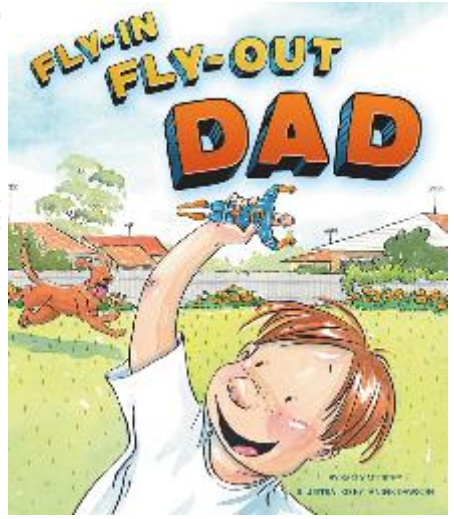
https://www.uboat-bases.com/en/home.html



Greenfield's 'tennis racquet' – the defining mission. SOURCE: PAUL GREENFIELD AND POPDOT MEDIA



Engineers Australia article, May 2015, p. 43



Goodreads.com

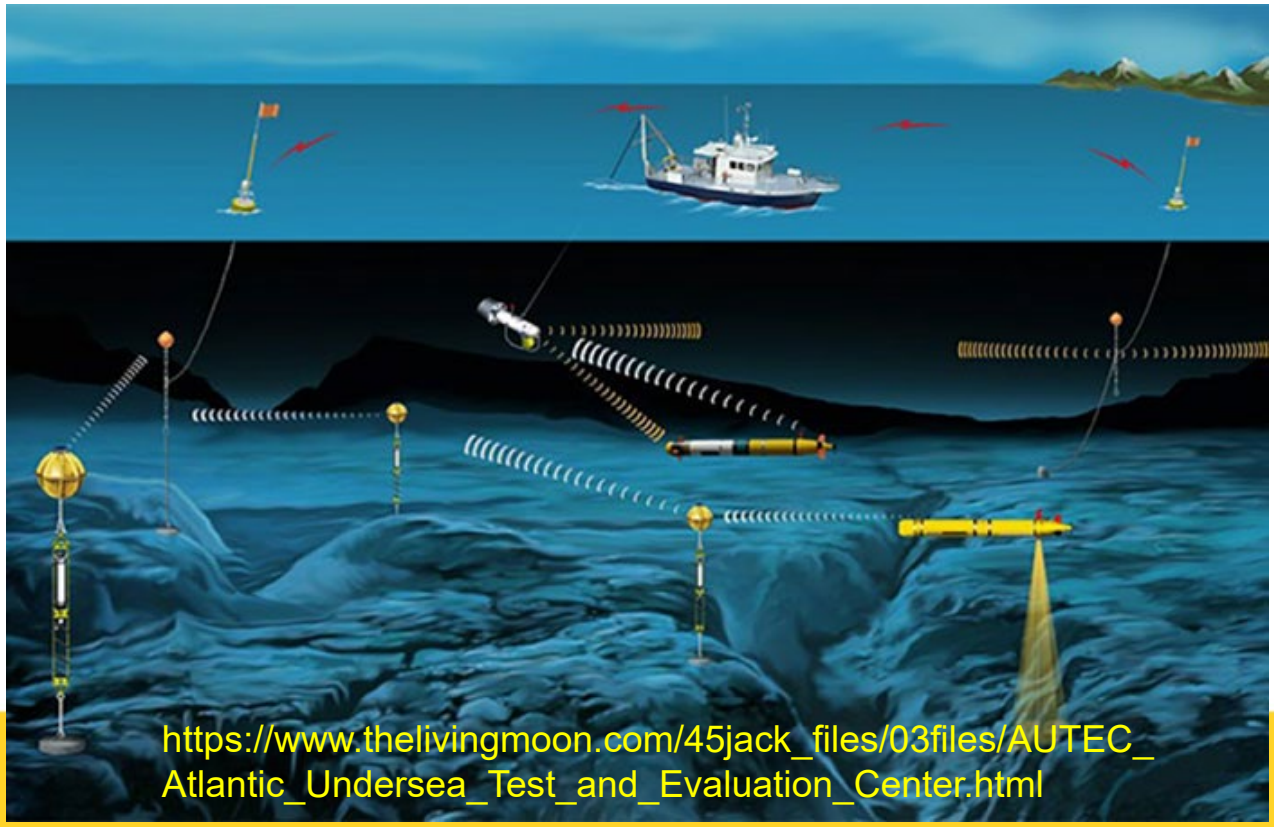
Truver (2015) notes a review of over 1000 PRC documents on the topic of mine warfare concluded:

- *the PRC have a large inventory of naval mines;*
- *they are likely to use those mines in any Taiwan scenario; &*
- *the PRC are assessed as both able to deploy their mines & use them effectively*

Australian Defence has focused significant investment in counter-sea-mining through new dedicated vessels and autonomous underwater vehicles. Combining these autonomous counter-mine capabilities with a versatile modern submarine offers significant utility in the Indo-Pacific confluence whenever any subterfuge is required, particularly in garnering evidence that could be crucia to coalition action.

See https://venturaapdr.partica.online/apdr/apdr-june-2018/features/ ; pictures courtesy Seber, SAAB & Kongsberg

- Advance Australia's SEA 1350 deep, shallow and portable water tracking ranges;
- ensure those ranges include maritime air-tracking (i.e integrated)
- begin allied counter-mine warfare exercises with USMC LCS using the Australian ranges
- develop a fixed & a deployable future submarine payload test bay



https://www.thelivingmoon.com/45jack_files/03files/AUTEC_Atlantic_Undersea_Test_and_Evaluation_Center.html

U.S. GAO in its report to Congress late last year state:

'*We found that from 2012 to 2017, DOD testers routinely found mission-critical cyber vulnerabilities in nearly all weapon systems that were under development. Using relatively simple tools and techniques, testers were able to take control of these systems and largely operate undetected. In some cases, system operators were unable to effectively respond to the hacks. Furthermore, DOD does not know the full scale of its weapon system vulnerabilities because, for a number of reasons, tests were limited in scope and sophistication.'* [p. 22]

By extension Australia's submarine capabilities, especially Collins-class, will have unassessed vulnerabilities & risks, that in turn require active cyber-defense teams & capabilities.

bbc.com

Cybersecurity methods like Nejib et al. (2017) are harder to apply to legacy capabilities like the *Collins-class* submarine & the attack surface of the associated supply chain & networked capabilities – all of which must last another 27 years. They:

- were not designed to resist such malicious intents,
- have too little funding already due to other forms of obsolescence,
- supply chains are often already tenuous & lack options, &
- lack the necessary test infrastructure

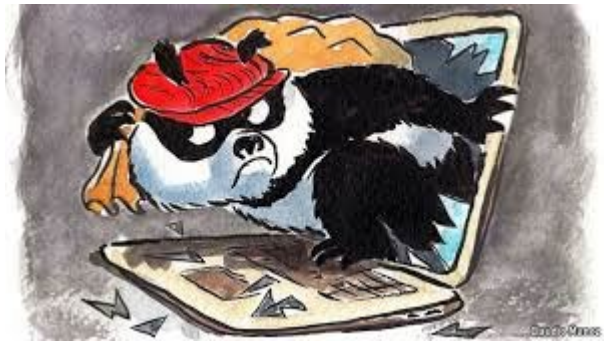
Technologies in watchdog AI or cyber-sidecars being developed to help defend legacy systems from cyber threats, but the inescapable hard graft needed is in:

- developing more cyber-defenders,
- securing the supply chain,
- developing overlooked representative test infrastructure,
- federating that test infrastructure and
- then applying continuous sprints of threat monitoring, evaluation, defence, counter-measure, re-evaluate, and risk assessment (i.e., cyber table-topping).

- For *Collins-class* submarine the above must all occur while in competition with future submarine for the same resources

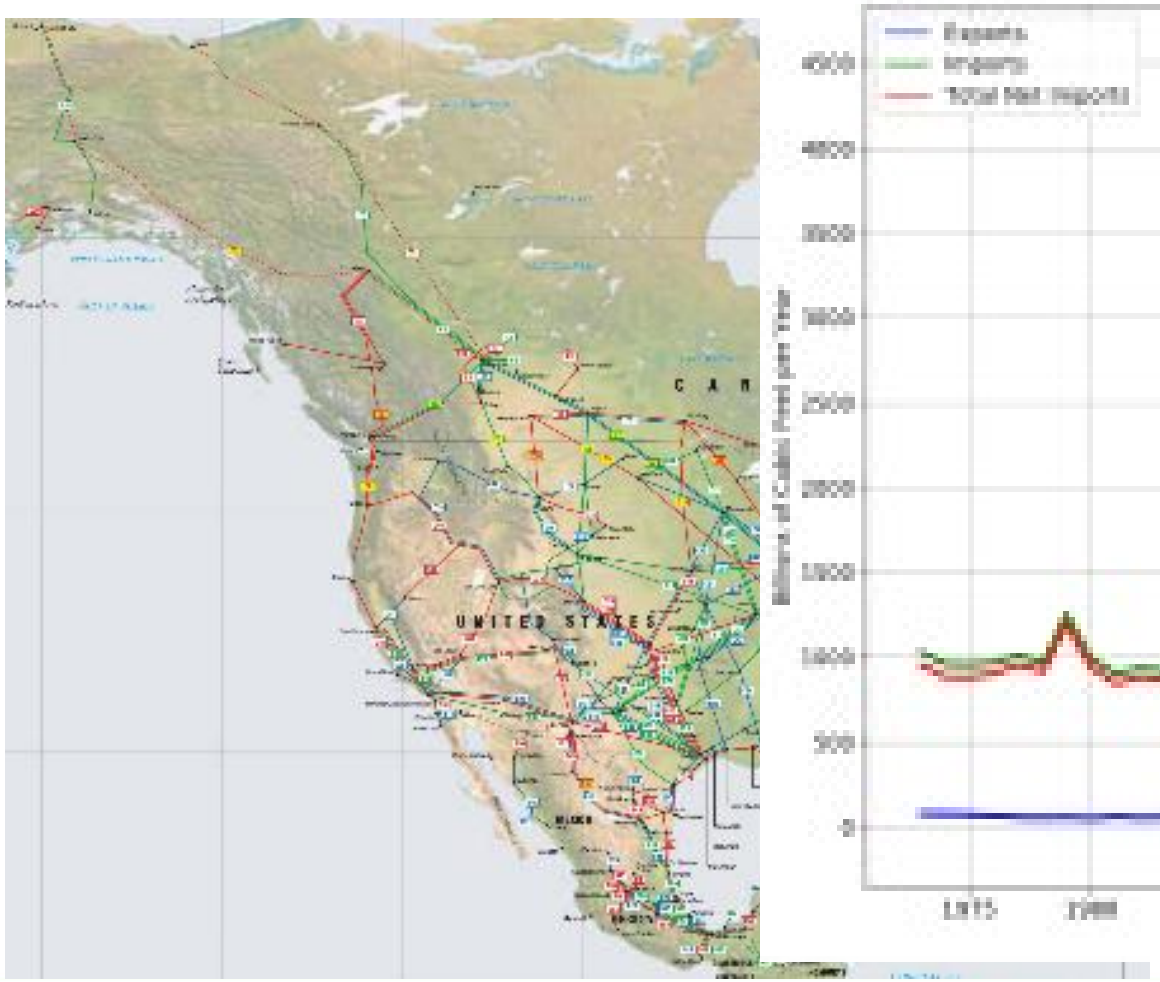
- Australia has cyber-security policy & has recently announced significant investment in new cybersecurity personnel & infrastructure

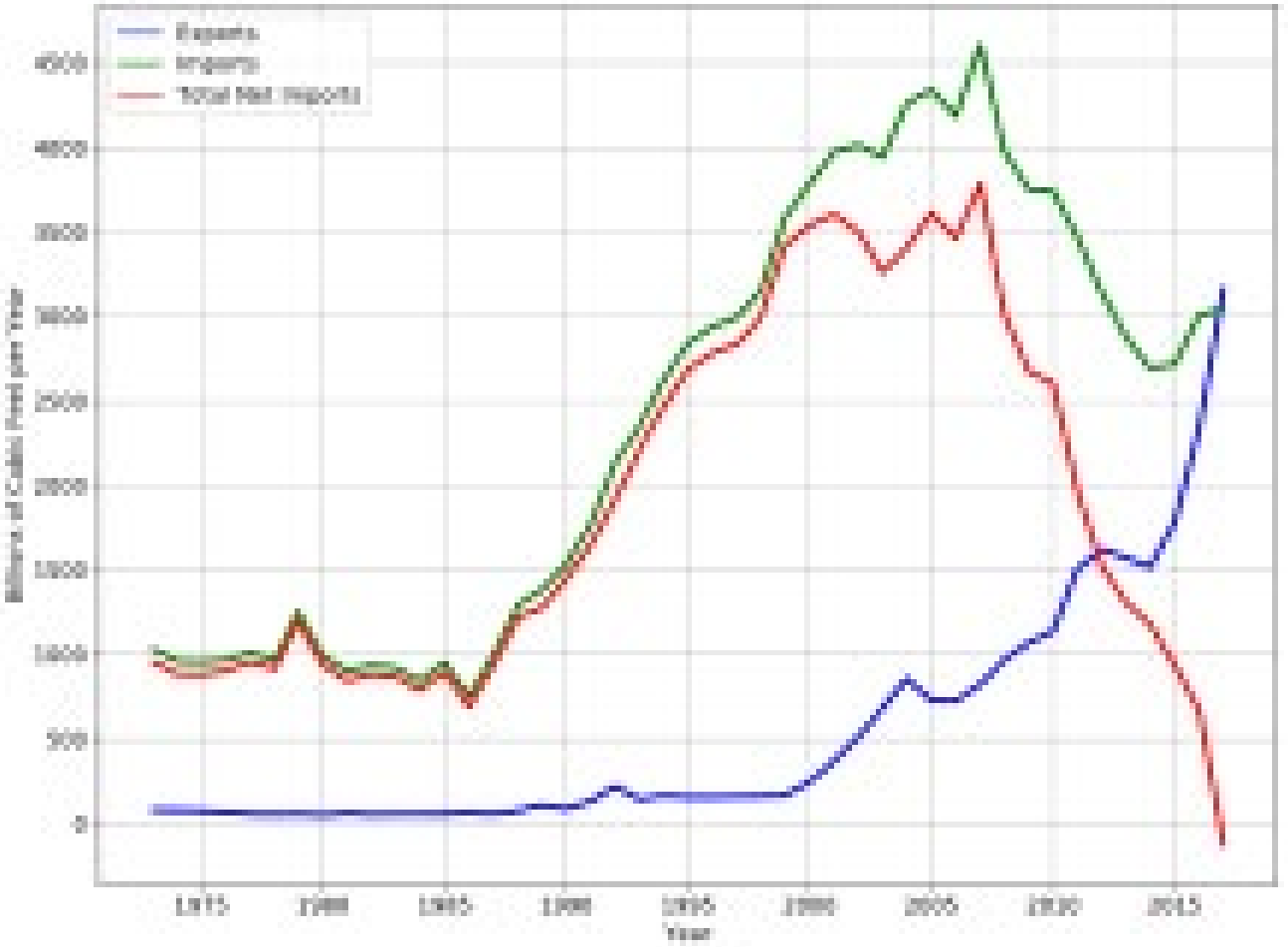
- The early focus of this investment on defending both legacy & new submarine capabilities will be evident when Collins-class security mitigations are a funded project.



economist.com

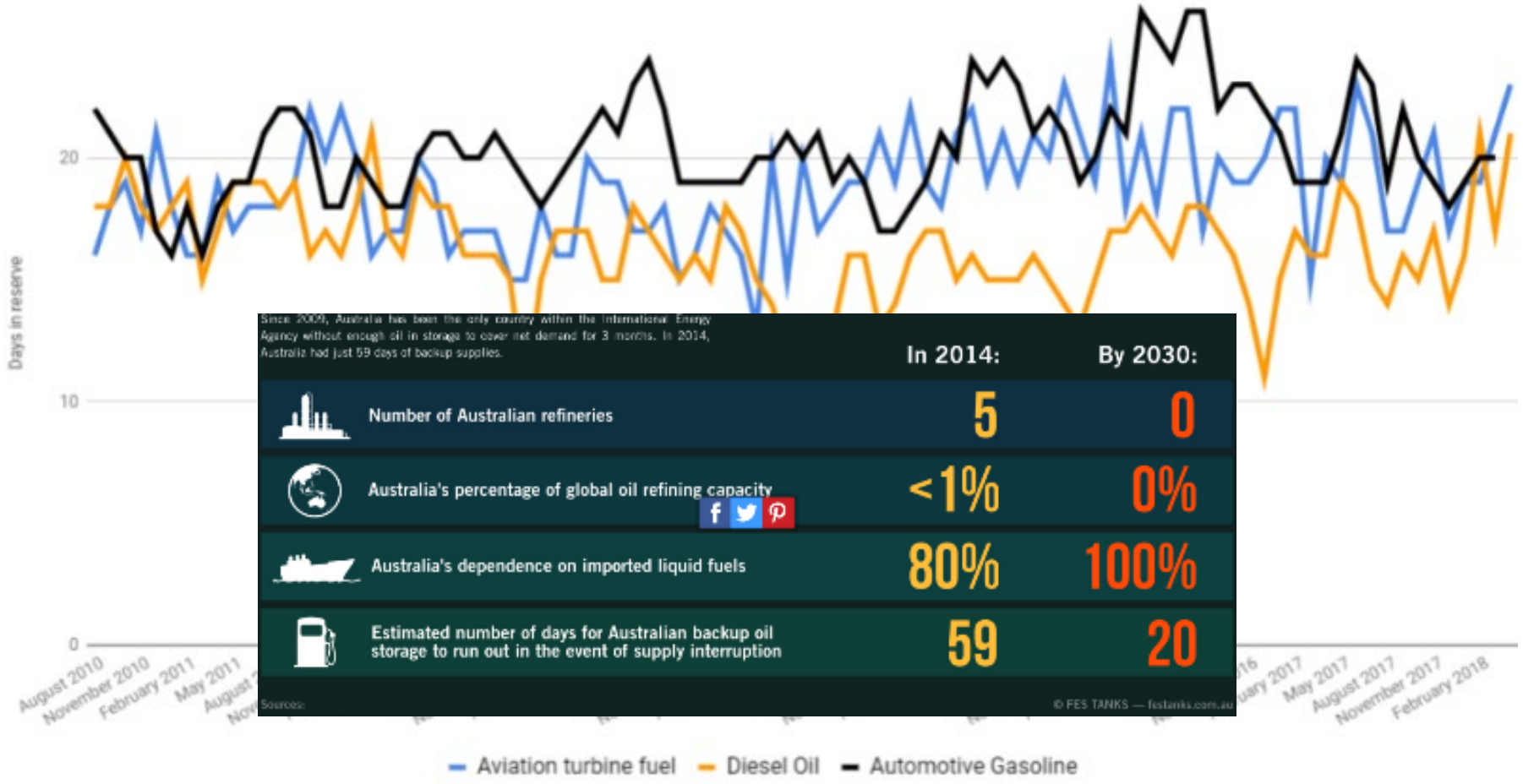
Post 2003 U.S. set out towards less reliance on oil from the Middle East:



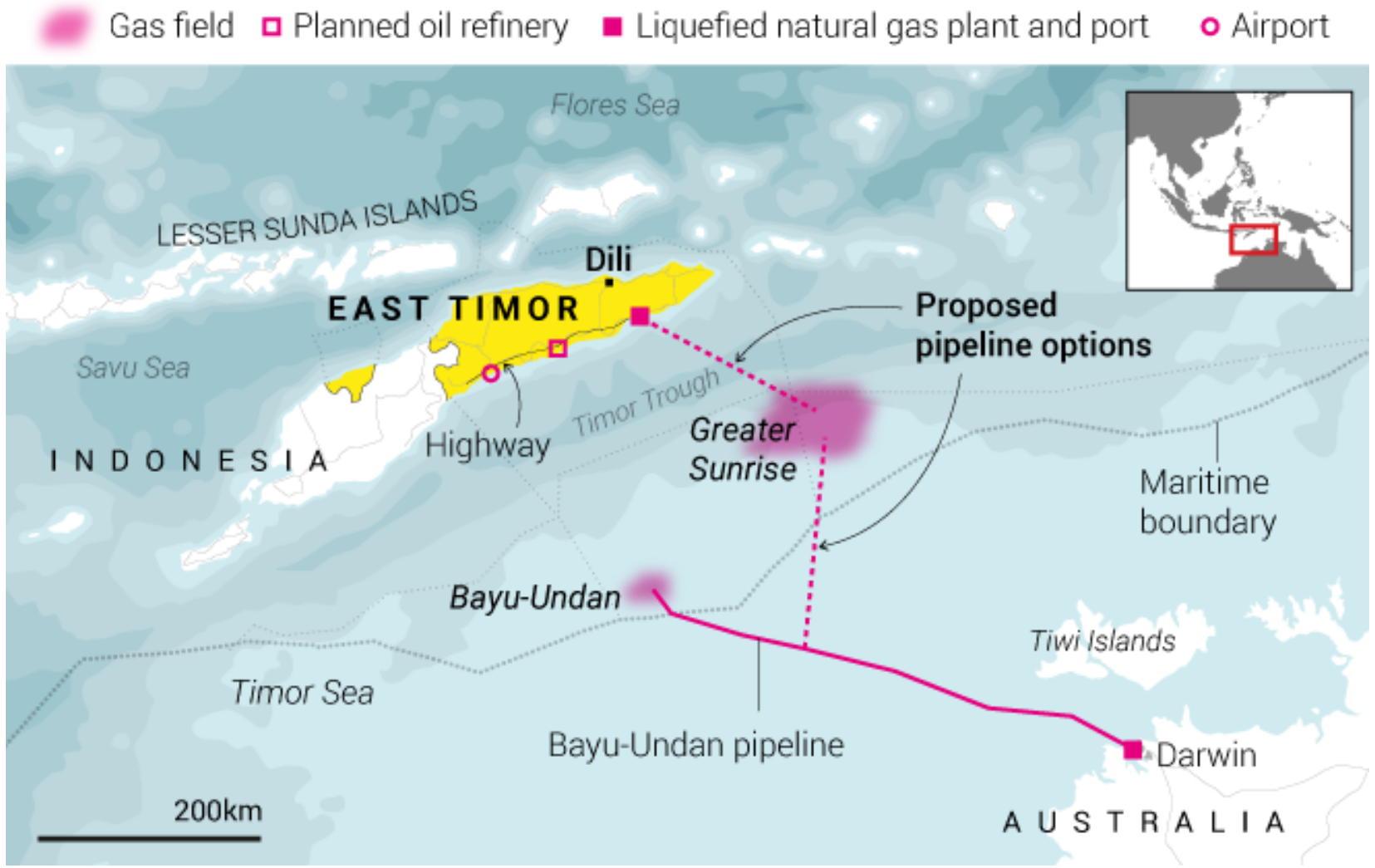


http://euanmearns.com/the-myth-of-us-self-sufficiency-in-crude-oil/ & Wikipedia respectively

In contrast Australia has been most lack of OECD by far

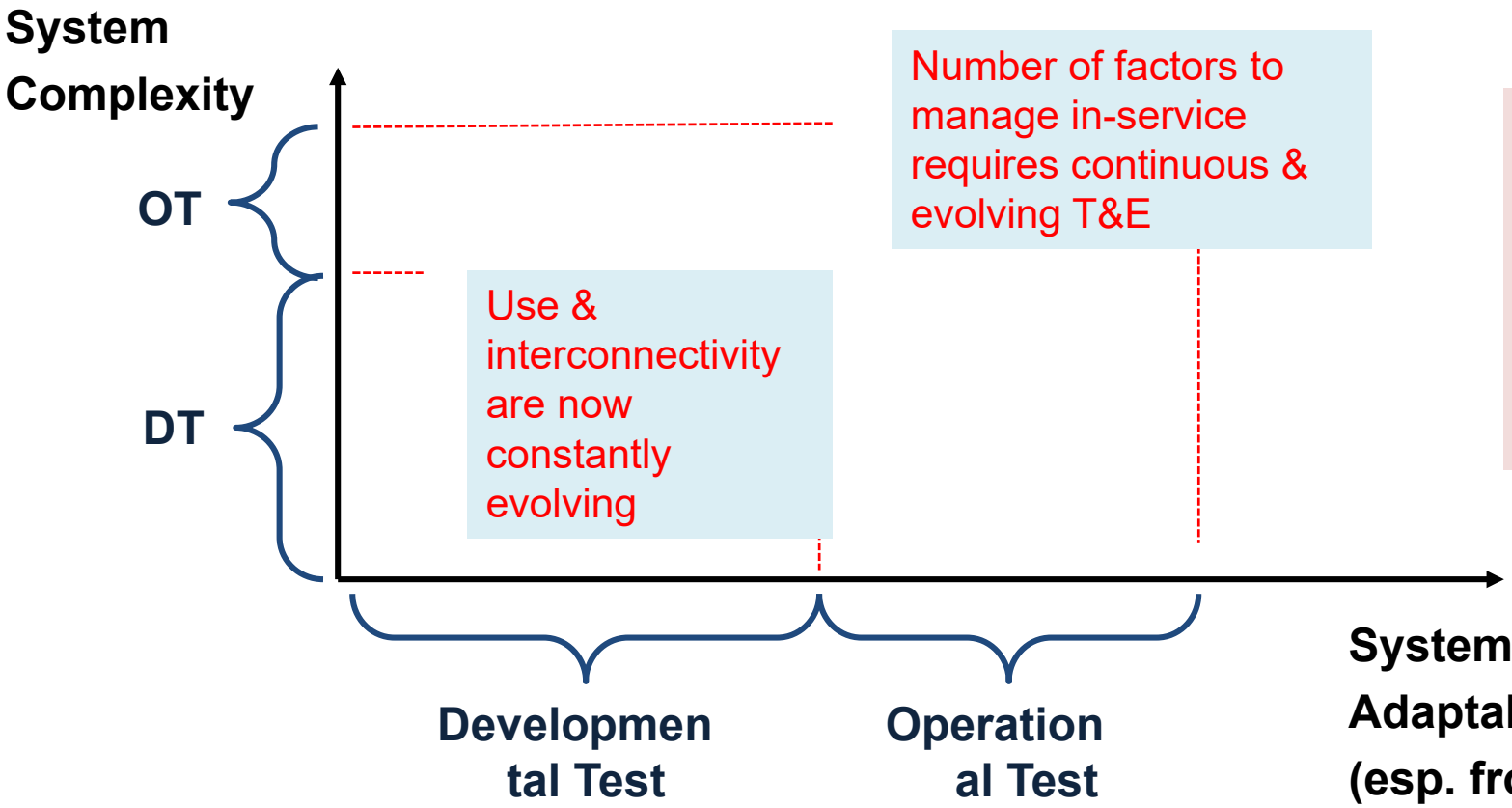


ABC News 23 May 2018, 4:46pm 'How many days worth of fuel does Australia have?' Source: Australian Petroleum Statistics, March 2018 & festanks.com.au



- $B 6.5 per refinery
- Cheap Timor labor by FIFO or high-speed ferry with 90% owners
- Refinery Storage on mainland
- Avoids vulnerable deep-sea trench

South China Morning Post, 'East Timor wants to tap oil and gas near Australia, so why is it courting China?' Meaghan Tobin, 3 Aug, 2019

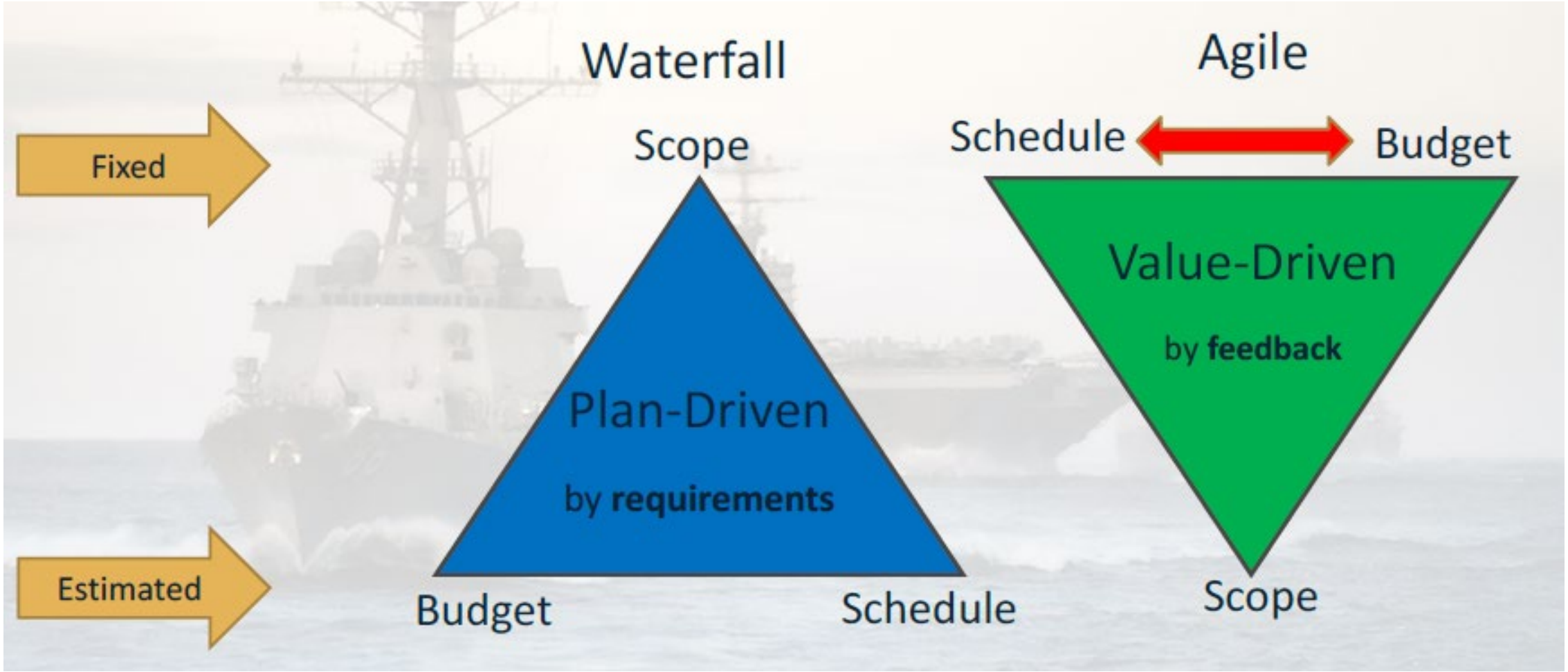


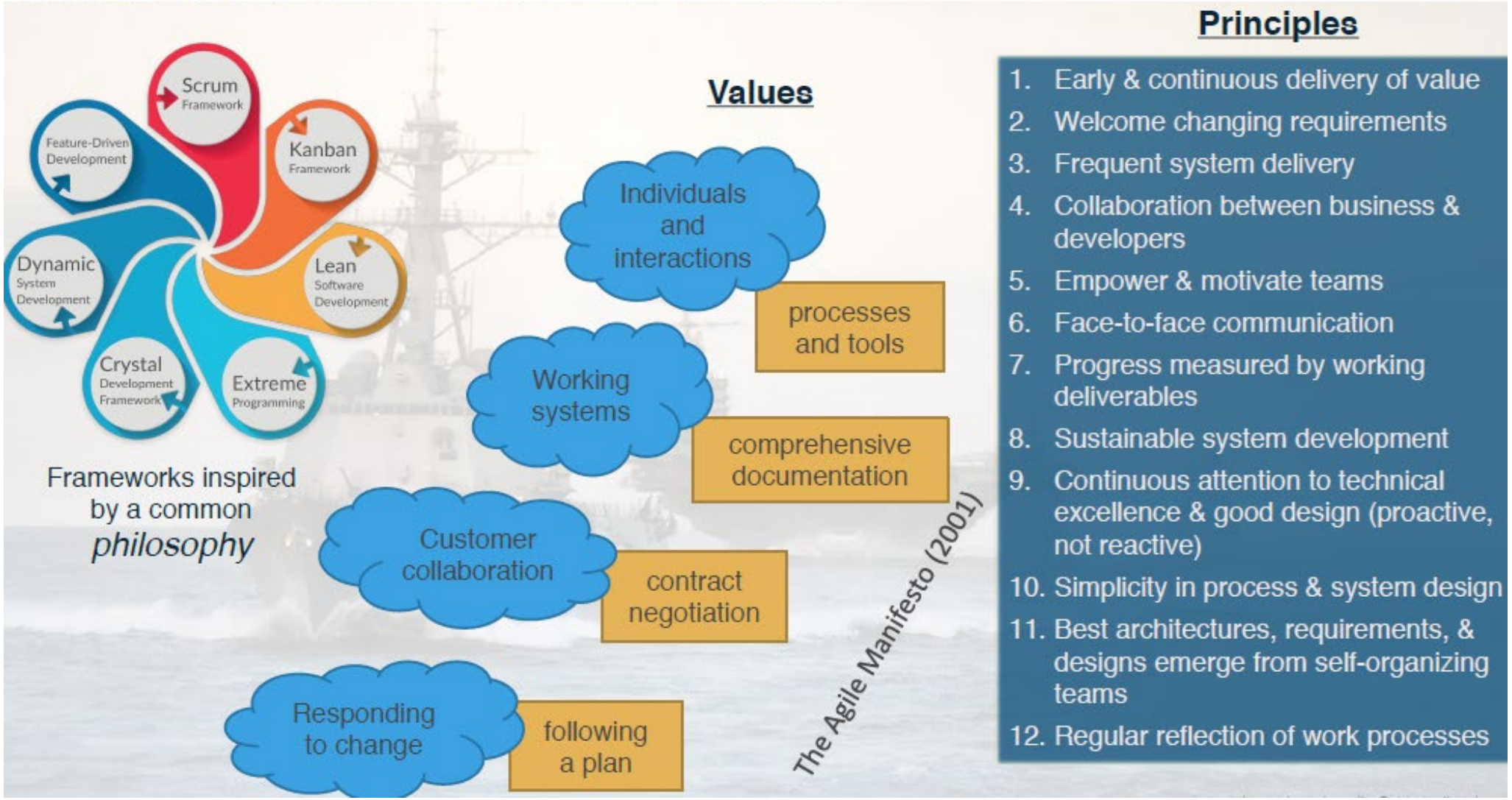
Significant change-agents:

- Cyber-threats
- ICT (networking)
- AI (autonomy)

Change demand is:

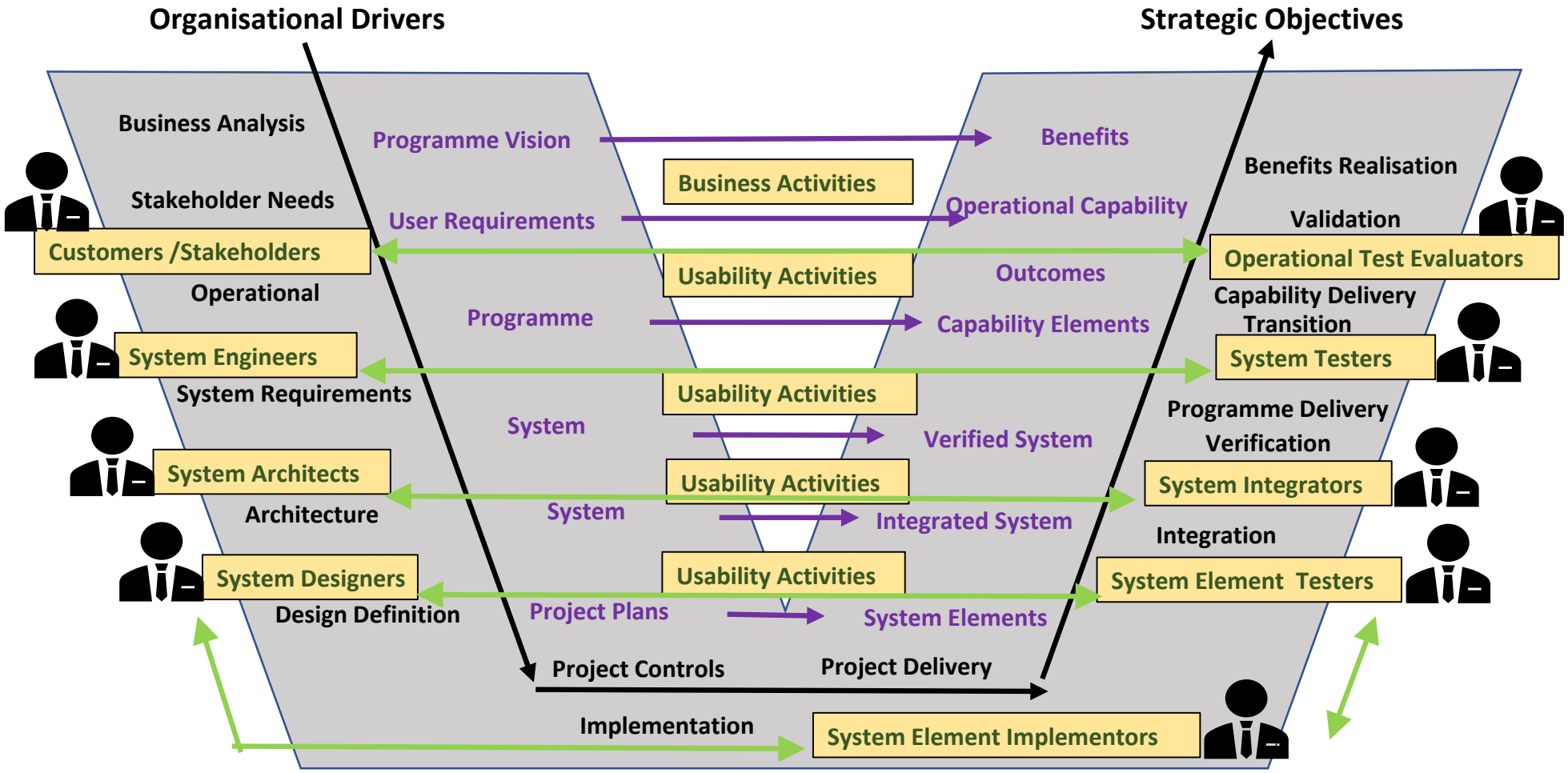
- Persistent
- Advanced
- Customer/operator-led
- Threat-led


Waterfall
Fixed
Scope
Plan-Driven
by requirements
Estimated
Budget
Schedule
Agile
Schedule
Budget
Value-Driven
by feedback
Scope


Scrum Framework
Feature-Driven Development
Kanban Framework
Dynamic System Development
Lean Software Development
Crystal Development Framework
Extreme Programming
Frameworks inspired by a common *philosophy*
Values
Individuals and interactions
processes and tools
Working systems
comprehensive documentation
Customer collaboration
contract negotiation
Responding to change
following a plan
The Agile Manifesto (2001)
Principles
1. Early & continuous delivery of value
2. Welcome changing requirements
3. Frequent system delivery
4. Collaboration between business & developers
5. Empower & motivate teams
6. Face-to-face communication
7. Progress measured by working deliverables
8. Sustainable system development
9. Continuous attention to technical excellence & good design (proactive, not reactive)
10. Simplicity in process & system design
11. Best architectures, requirements, & designs emerge from self-organizing teams
12. Regular reflection of work processes

Agile-like Compromise via flexible policy, co-development, change management

Illustration of PM & SE integration using Vee Model & usability activities to reinforce key communications (adapted from Gray et al. (2017), Hoehne (2017) & Joiner et al. (2018))



Summary is anything to promote:

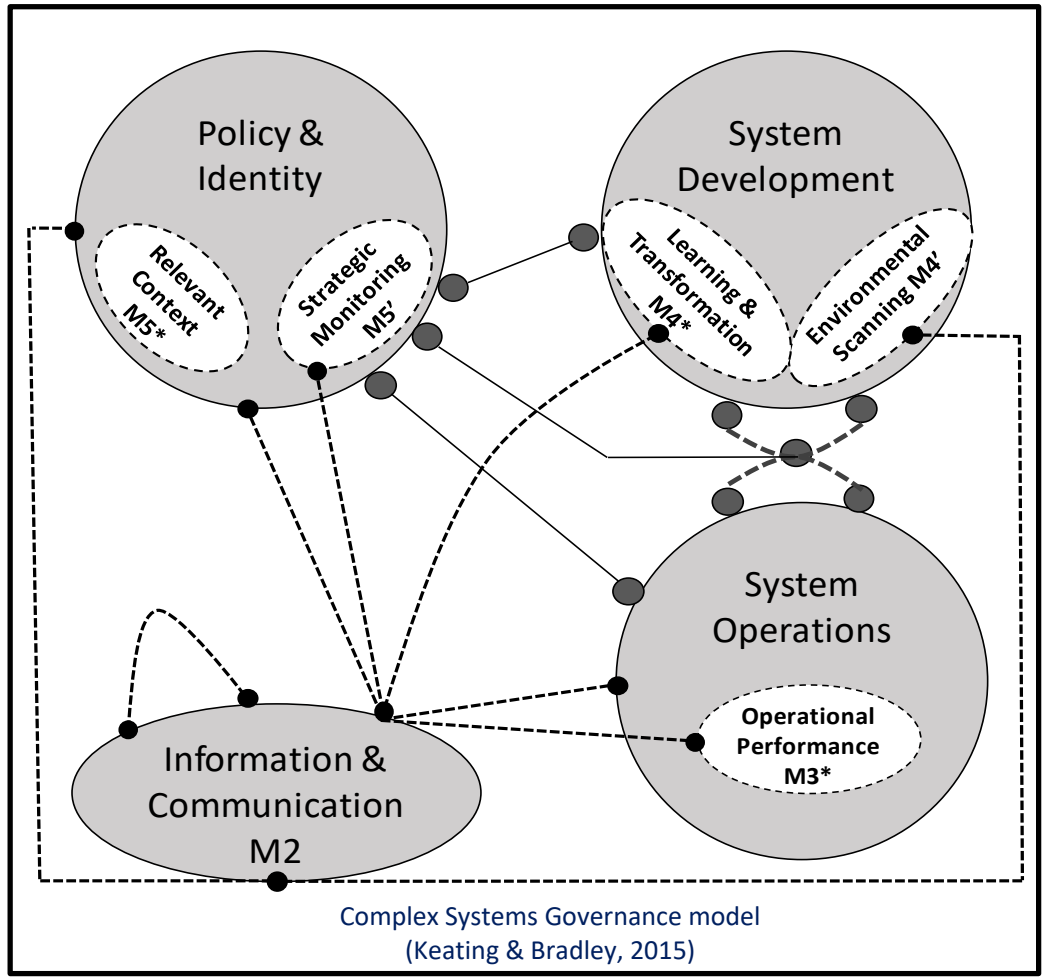
- Teaming
- Collaboration
- Communication
- Alignment

Continual build of understanding through regular interaction relationships with users & active product owner with decision-making authority

Self-organizing teams adapting processes for effectiveness & efficiency

Transparency/visibility tools & practices, standardized documentation

Agility implied by Complex Systems Governance



Complex Systems Governance model
(Keating & Bradley, 2015)

Regular retrospective event after sprints and releases

Feedback during development with cross-functional team

Rapid, regular delivery of value demonstrated in operational environment

Agile Development improves outcomes when we…

prioritize *work,*

develop ***collaborative solutions*** *with our customer,*

empower our team to utilize their unique knowledge,

promote ***transparency*** *to enhance coordination and team knowledge,*

deliver results ***often*** *(shorter milestones),*

learn from ***feedback****,*

anticipate and ***adapt*** *to change,*

regularly ***reflect*** *upon work processes.*

Conclusions

Radius:

- Develop dedicated mobile replenishment ships & submarine docking pens at Joint Base Manus.
- Air defence of Joint Base Manus & make FIFO arrangements for submarine & aircrew from mobile & fixed replenishment sites.
- •

Asymmetric Threats/Evolving warfare:

- Enhanced training & testing through accelerating the HMAS Stirling deep-to-shallow-water tracking range along with an integrated air range capability.
- Counter expected cyber-warfare asymmetric threat to submarines by prioritising U.S. cybersecurity collaborative trials & remediation and overwatch of legacy systems.
- Counter expected mine-warfare asymmetric threats to maritime activities by prioritising U.S. collaborative trials in autonomous mine clearing as developed with the USMC littoral combat ships.
- • Accelerate the future submarine development by adopting agile systems development strategies, largely through novel contracting approaches, and investment in the ship-systems test infrastructure and personnel development programs necessary to ably apply agile frameworks to support prototyping efforts.

Agile approaches:

- Adopt the complex systems governance framework for the submarine program, starting with the entry-level assessment
- Develop agile management approaches to improve resilience to complexities, leverage innovation & respond quicker