FACULTY OF ENGINEERING

NAVAL ARCHITECTURE AND MARINE ENGINEERING

UCL

Meeting future ASW challenges and exploring future UWW concepts

Wargaming as a Concept Analysis Tool

Underwater Defence & Security A
CNE Farnborough, 21st May 2024

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Agenda

- What is Wargaming?
- Wargaming at UCL
- Why do we use it?
  - Strategic, operational, tactical
  - Other users
- UWW Concept Analysis
  - Critical Undersea Infrastructure
  - NATO NSSE Offboard Systems ASW Campaign
- Conclusion

Who am I?

- Naval architect, Constructor Captain, RCNC
- Worked in the MOD for 30+ years
- Project naval architect for T22, T23 FFG and Astute SSN
- Currently the MOD Professor of Naval Architecture at UCL

- Specialist in warship survivability and weapon effects since 2000
- Secondment to Dstl, survivability R&D
- Lead the RN Survivability Strategy
- Technical adviser to all current RN and RFA ship and submarine projects, and to weapon projects on lethality
- Lead UK investigator in the ROKS Cheonan and HSV SWIFT inquiries
- Regular advisor to MOD agencies on emerging incidents, threats etc.

What is Wargaming?

- the action of playing a war game as a leisure activity or exercise in personal development.
- the action of engaging in a campaign or course of action using the strategies of a military exercise.
- Played using miniatures, counters, or in an abstract form (especially matrix games)
- Played using a defined set of rules which reflect the perceived or actual realities of technology, capability, command and control etc.

Historical Use of Serious Games in Naval Applications

US Naval War College

Western Approaches Tactical Unit (WATU

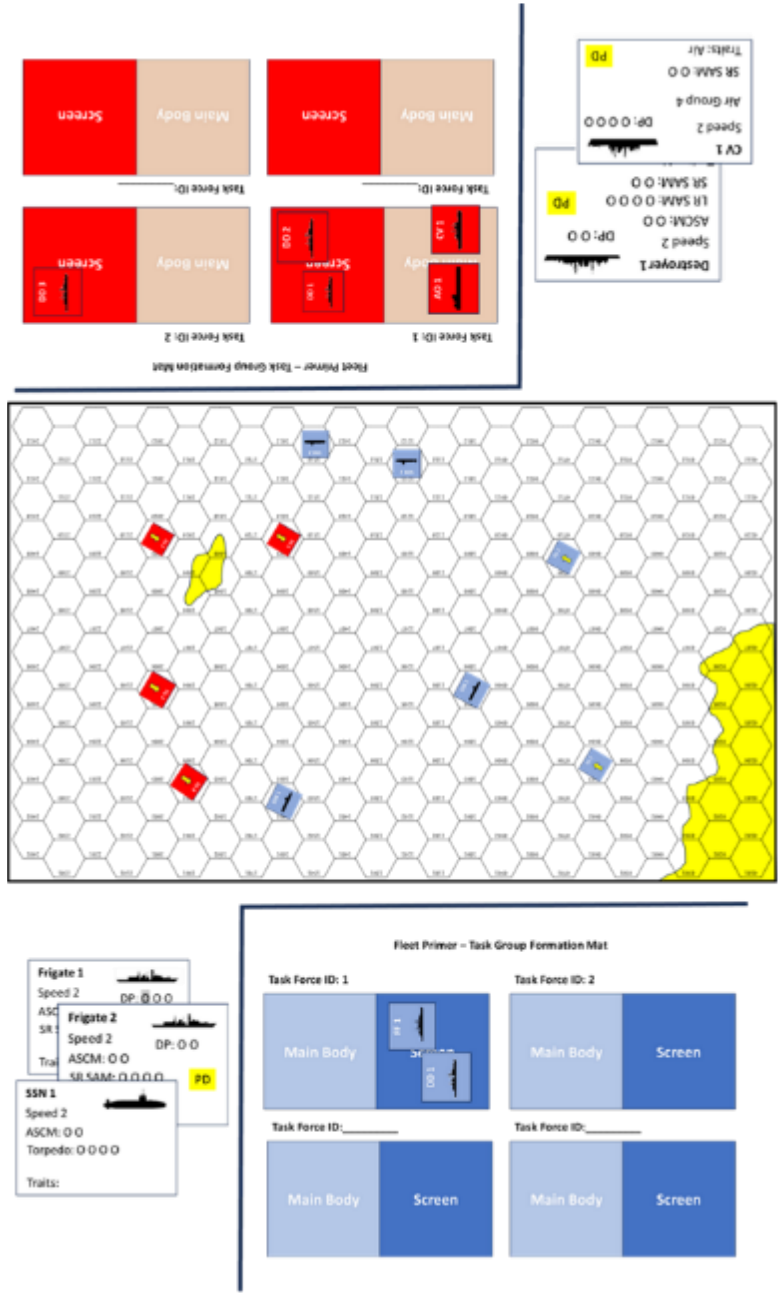
Wargaming at UCL

- To train and raise student awareness in maritime and joint operations, capability aspects of warship design
- To rapidly assess design options at platform and force level
  - “desk level” operational analysis
  - *Noting that “wargaming is NOT” operational analysis” (Stephen Downes-Martin, Connections US 2023)*

- Examples:
  - Understanding how maritime, land and air forces can work together in a multi dimensional littoral operation.
  - Demonstrate the benefits of platform and UXV survivability on Mission Success
  - Determining the effectiveness of an anti air warfare system in a particular environment
  - Determining minimum / desirable air group composition for an aircraft carrier
  - Understand the role and capability required in a Seabed Operations Vessel

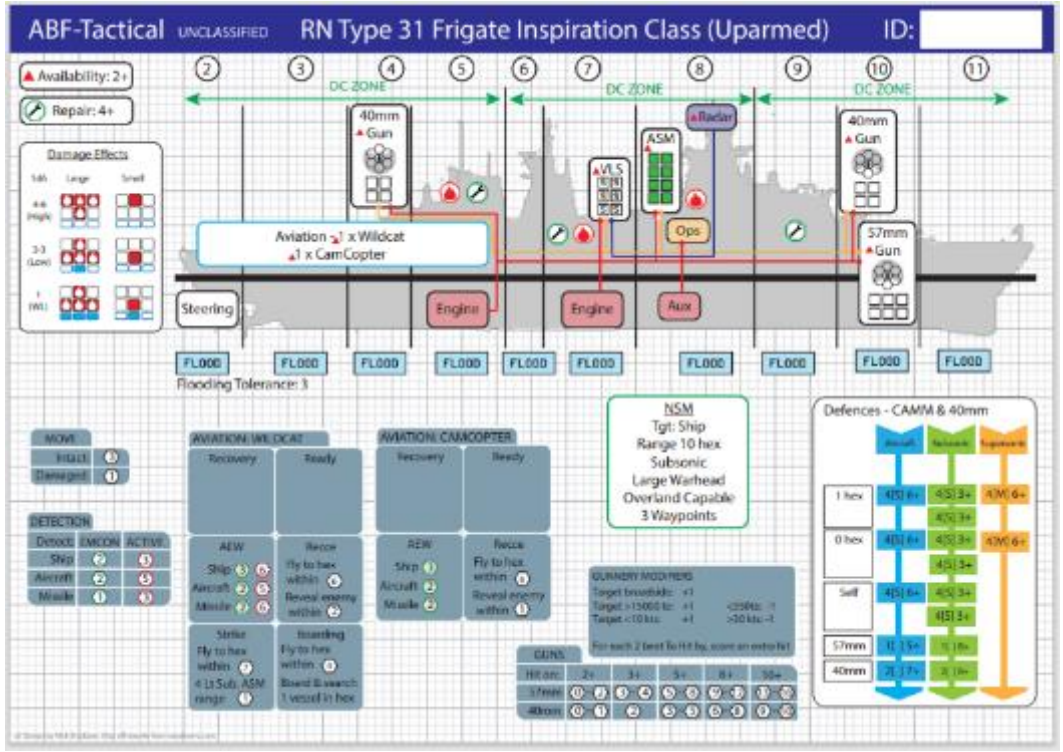
“Fleet Command”

- Introduce students and others to the wider conduct of naval operations at the task group level
- Demonstrate the role of different ship types, how they come together and work together in squadrons, Task Groups and fleets
- Demonstrate how naval forces interact with land and air forces.
- Highlight the impact of different capability choices, such as enhanced resilience to weapon damage, signature control, long range and high speed weapons, etc.
- Developing use by the UK Maritime Warfare Centre and elsewhere



“A Balanced Fleet”

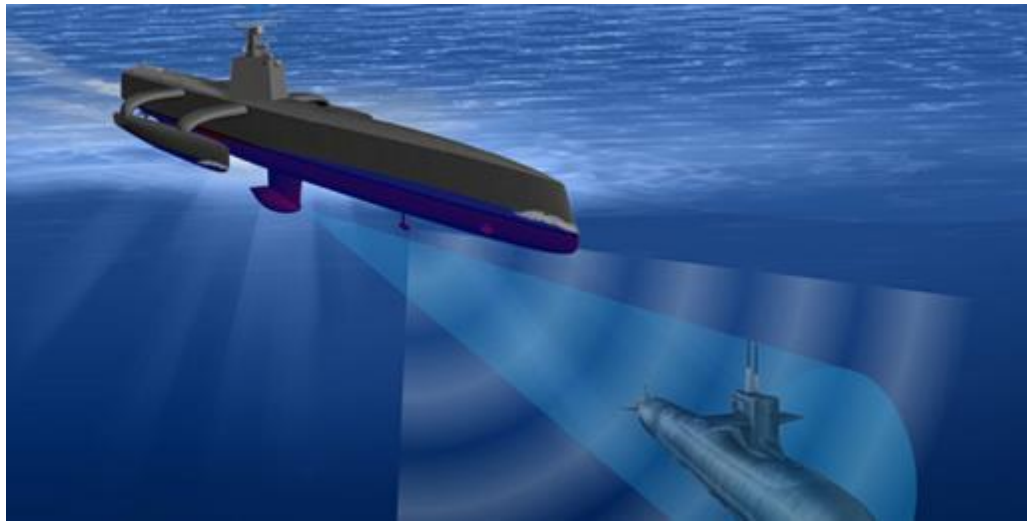
- Our primary game for surface ship design support
- Developed over 10+ years
- F2F or double blind
- Allows detailed representation of student designs (and real world ships)
- Missile engagement model allows assessment of self-defence capabilities
- System layout and other design aspects allow assessment of ship survivability
- Significant upgrades in ASW



UWW Concepts Investigation

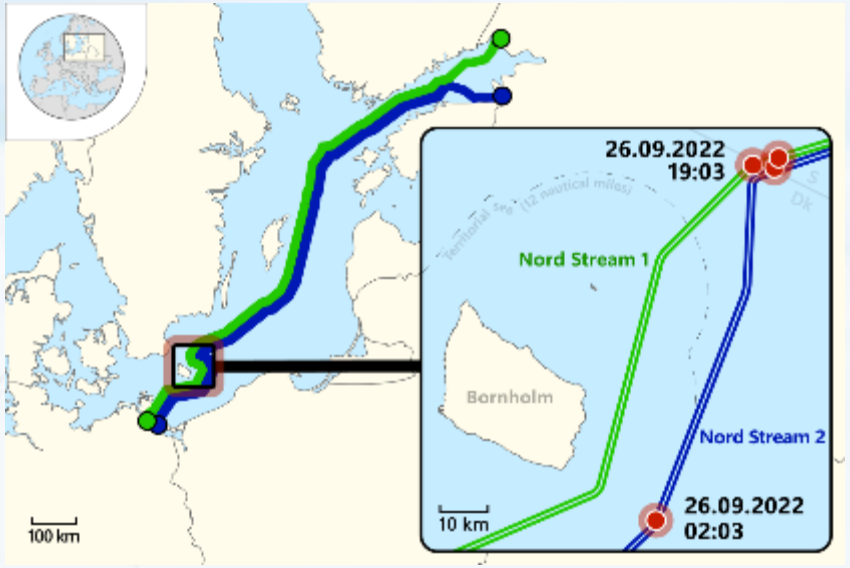
- Protection of Critical Undersea Infrastructure (CUI)

- Use of offboard systems for anti submarine warfare (ASW)



Seabed Security

- Not a “new” subject. e.g. War of the Pacific, 1879
- A current and clear area of extreme interest, thrown into focus by the Nordstream pipeline explosion
- National and international communications
- Energy security
- Information security



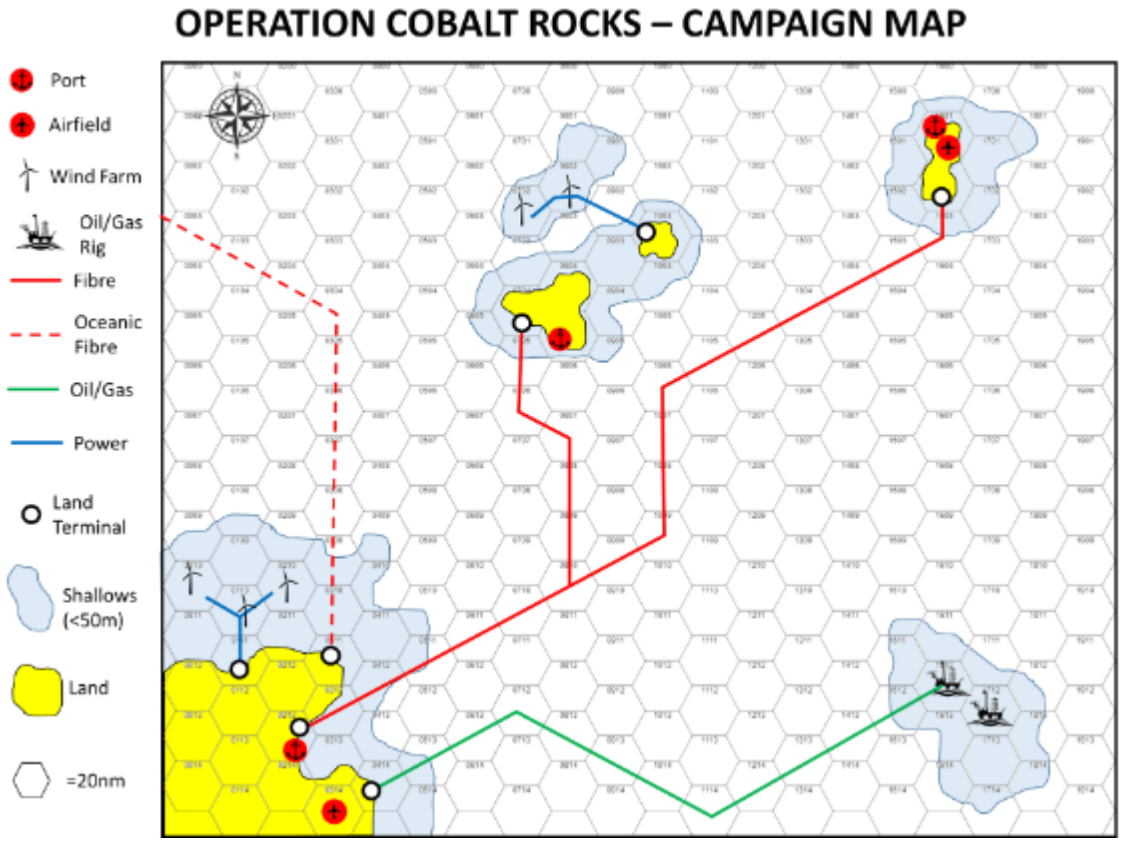
Capability Design Challenge

- MDT tasked with developing a design for a Seabed Operations Vessel
- Against a set of requirements, including interaction with, and protection of, seabed infrastructure in home waters and in an expeditionary mode
- Team members were unfamiliar with the concepts and operations involved
- Exploration of these aspects through wargaming, with a view to informing and influencing the developing design of the ship and its systems

Seabed Operations

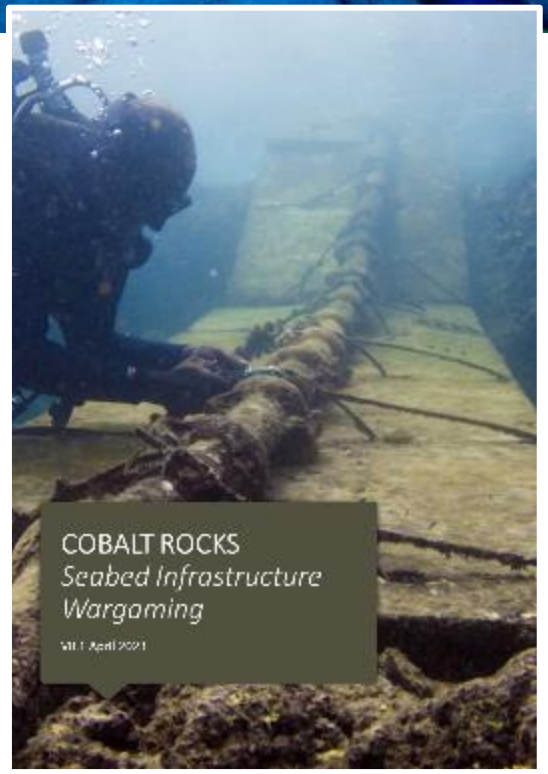
"Cobalt Rocks"

- Design and operation of seabed warfare vessels
- Development of national infrastructure protection systems
- Assessment of concepts for critical seabed infrastructure surveillance, protection and incident investigation
- By-products for "red" considerations



Cobalt Rocks

- Attack and Defence Concepts
- *Blue, Red and White teams develop thoughts on methods of attack and defence (along with counters to their proposals)*
- Initial phase – national defence infrastructure definition
- *or deploy within an existing infrastructure (e.g. friendly nation support)*
- Planning phase – Blue and Red plan their operations in detail for each scenario
- Execution phase - An events-based wargame, transitioning into a traditional wargame as triggers are met
- *Double blind*
- Scenario End Phase
- *Lessons identified, consider changes for next scenario*

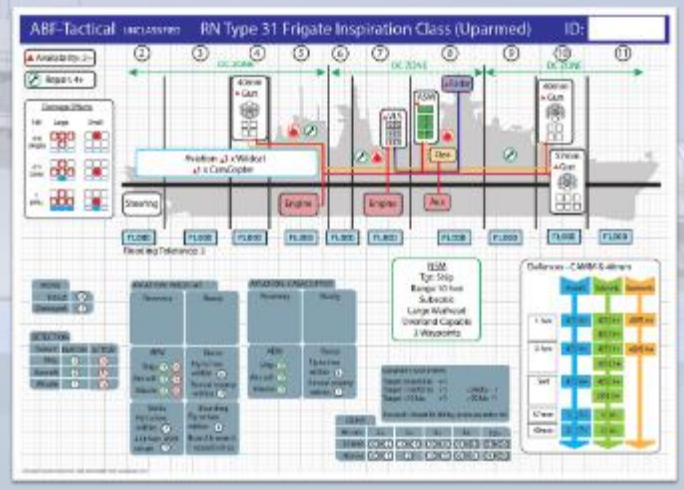


Lessons Identified

- “Its really difficult”
- Constant surveillance
- Close observation as a deterrence
- Rapidity of response, at range
- Unified command structure or VERY effective interfaces
- Use of air assets
- Effective communications with deployed subsea assets at range
- Significant value in rapidly deployable UUV capability at distance
- *Concept developed for a UUV / UAV / comms link capability*

NATO ASW Project Wargames

- Carried out on behalf of NATO SDCG ST/NSSE
- Demonstration of wargaming applied as a concept assessment tool
- Using a realistic “high end warfighting” relevant to current NATO members and allies
- ASW barrier using offboard systems selected as the concept for study
- Wargaming to find out if it is possible to protect an amphibious task group against enemy submarines using only offboard maritime unmanned systems instead of traditional anti-submarine warfare frigates
- Concepts explored through a 3 day wargaming “campaign” centred on a Non-combatant Evacuation Operation (NEO) in the face of a hostile threat
- Games run at the NDP offices in Filton, involving NSSE members, SMEs, “interested parties” and others



Conduct of Games

Ten games conducted over three days

Comparison of “legacy” force and a future “offboard enabled” force

Operations in the face of a competent “red” force equipped with SSKs and light surface/ air corces

Considered the following

- UUV, UAV, USV concepts as ISR and kinetic capabilities
- Additional capabilities to fill overall capability gaps identified

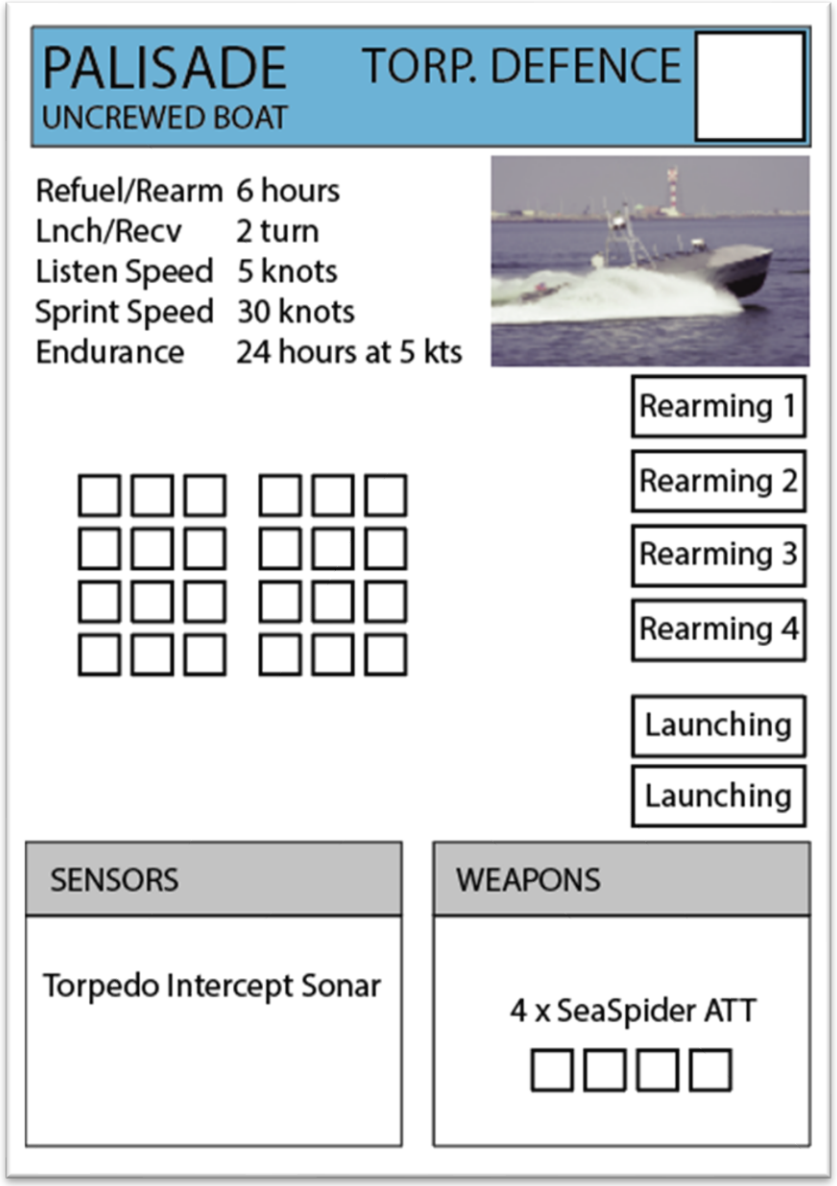
Hot wash conducted after each set of games, lessons identified and future games updated to reflect significant issues.

Agility – Rapid Tech Insertion

After Day 2, inserted:

- ASROC
- “Palisade” SSTD UXV
- Seabed Sensor Network

With SME data input, created capability cards overnight and introduced on Day 3



Key Outcomes (Summary)

- Effectiveness of USV towed arrays, especially where they bring the ability to add mass of sensors
- The absolute dependence of all uncrewed systems on a fully integrated, stable and robust mesh network solution for MUS C2 – A CRITICAL aspect for UUVs
- The very high positive impact of ASROC as a Blue asset
- Unexpected heavy use of Ship Launched Torpedo systems.
- Efficacy of a USV based Torpedo Decoy
- Heavy expenditure of sonobuoys
- Weather and environmental impacts
- Continued utility of crewed ASW helicopters in a UXV environment

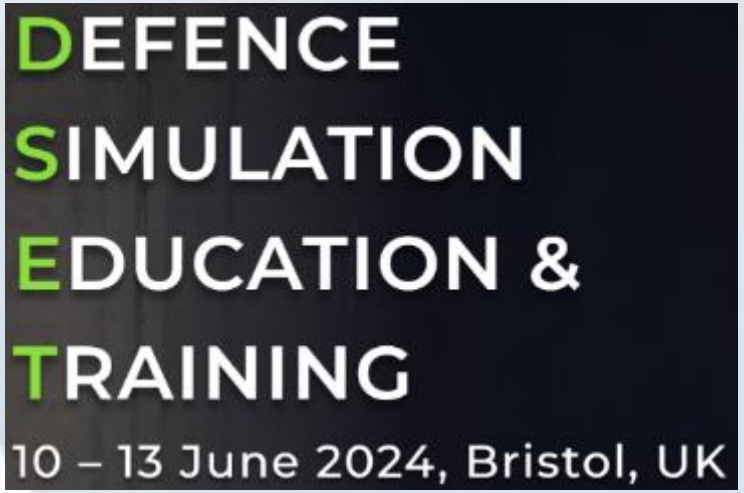
"Whilst all the above points are heavily caveated by the artificialities of game mechanics and nature of using unclassified data, vice real world, there is no doubt that these issues would warrant further exploration in a more developed gaming environment." - NATO ASW Barrier Project Director

Wargame Outcomes

- Did they work? – YES
- Benefits to exploring concepts – even with Open Source data
- Generated a great many insights of benefit to the NATO ASW Barrier Team
- Cobalt Rocks identified a number of design and operational areas for development
- Provided a bird’s-eye view before diving into detail
- Determine what questions to ask
- Agility of manual wargaming (with SME input)
- Identify disruptive technologies
- Identify technologies which do – or don’t - work well
- Identify gaps that could usefully be filled
- Instant arms race – counter, counter-counter
- 2nd/3rd order effects, “system” aspects, synergies

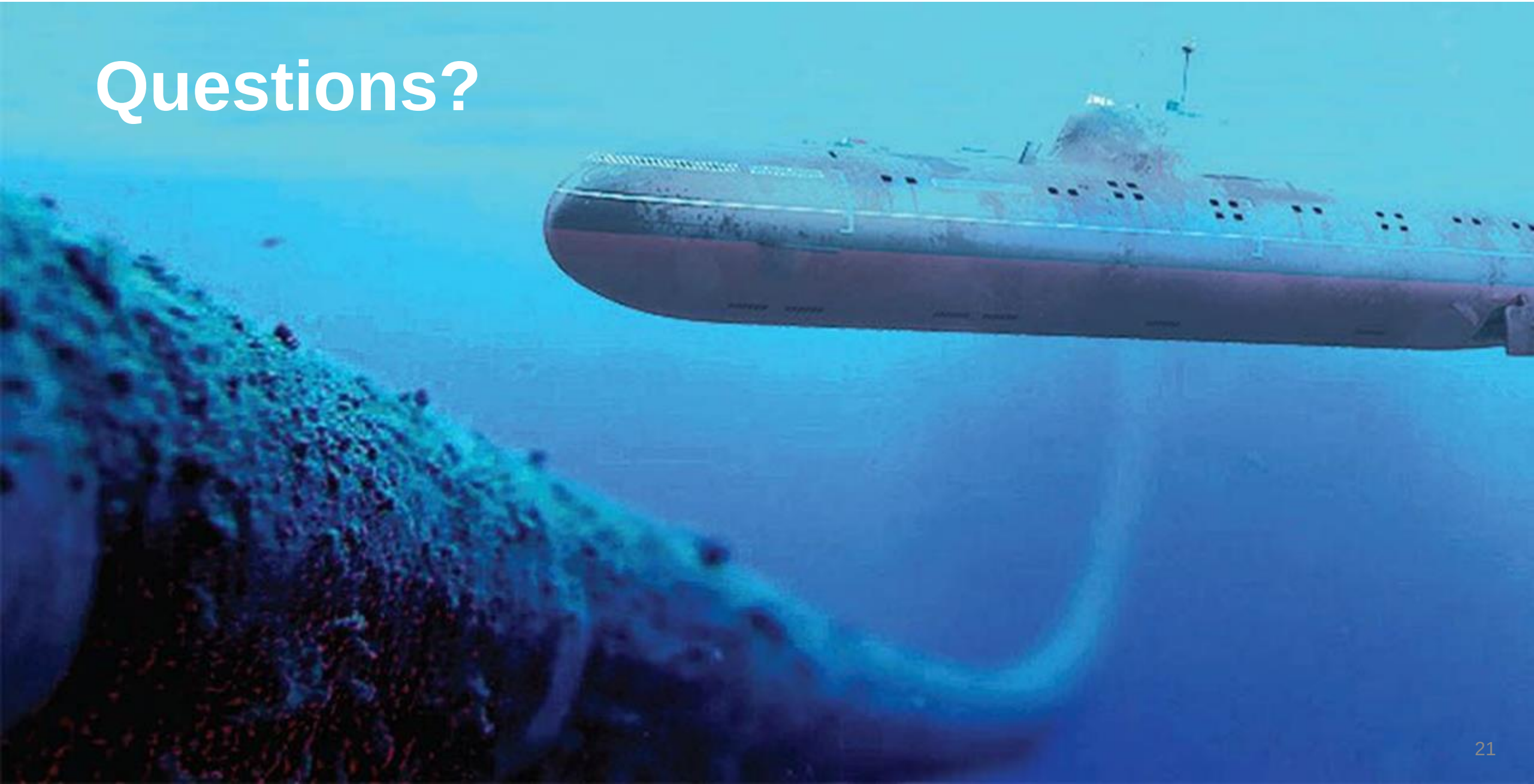
Conclusion

- Wargaming shown to have significant potential benefit in naval concept analysis
- UCL has developed a range of wargames that ably support its educational and design support requirements, supplementing its own games with commercial products where it is effective to do so
- Those games have obvious utility beyond the academic environment
- The benefits of learning and development activities using these games is already being felt in the UK naval environment
- Cobalt Rocks has generated interest in various UK, NATO and overseas agencies
- ASW wargame to be carried forward in a NATO context (Formal ASW Barrieranalysis), also generated work in DE&S (MRSS)
- Significant interest within Industry, UK and overseas, in using wargaming for concept analysis and team training
- There is always more to do…….



https://www.youtube.com/watch?v=cP6HzLB0DZI

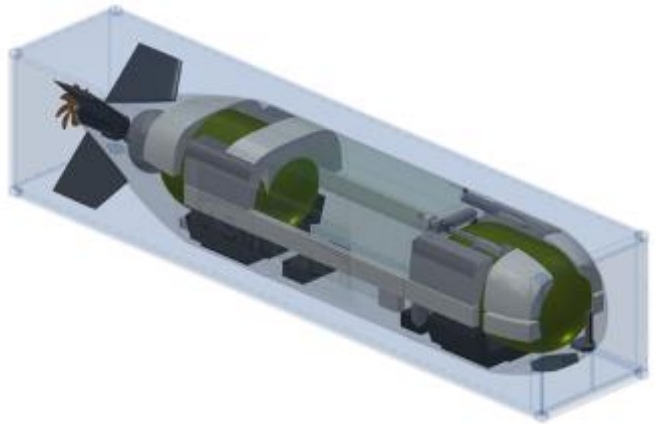
Questions?



Additional Slides

Attack / Defence Concepts

- Attack Modes
- *Kinetic, “Hack”, Recovery/Theft*
- Defence Modes
- *Surveillance, deterrence, Kinetic response, evidence recovery, attribution*
- Attack Vectors
- *Surface ship (overt, concealed), submarine, air-deployed*
- Example defensive concepts
- *Passive sonar in pipeline/cables, use of sonobuoys, UAS deployment of UUV and comms arrays, enhanced AIS monitoring*
- Example offensive concepts
- *UAV-deployed one-way UUV, seabed crawlers, covert deployment (e.g. moonpools), distraction, dedicated submarine assets (previous design exercise subjects)*

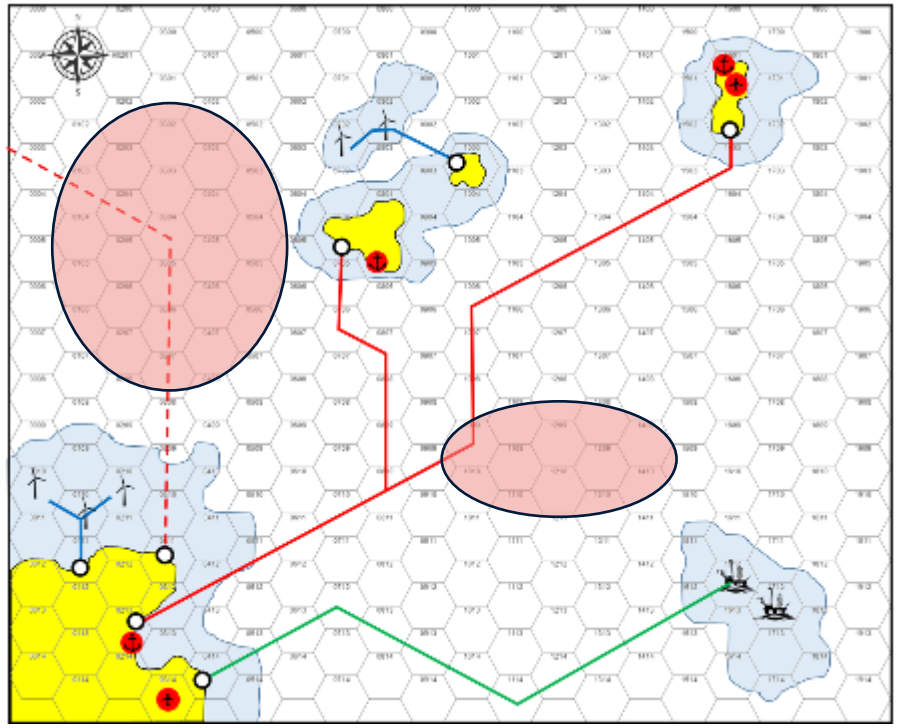


Cobalt Rocks – Game Execution

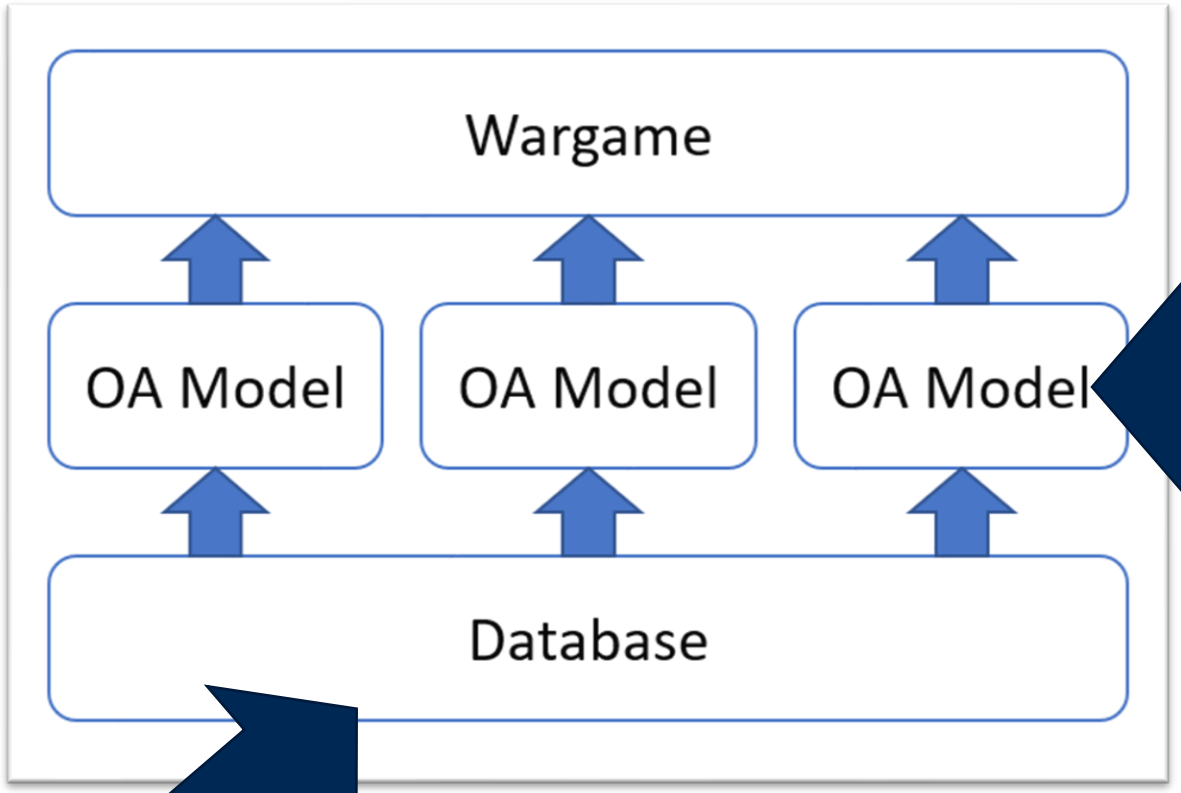
- Blue, Red and Green plans pre-determined
- White cell adjudicates movements and actions based on plans, determines points at which events are triggered and moves to tabletop at that point
- ***Note that it is possible for a scenario to be resolved with NO INTERACTIONS. In one example, Red was able to achieve mission success and withdraw without Blue becoming aware of their activities at any stage*
- Each turn, teams record movement and actions – and reasons
- Execute orders and resolve actions.
- Blue, Red and White note any particular observations and learning points as the game progresses

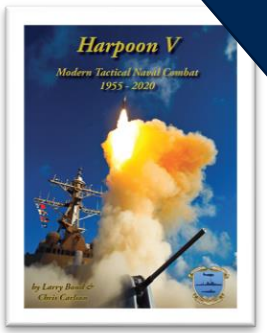
Cobalt Rocks – Game Example

- Red SOV deployed and obvious to the NW
- Blue based their OPLAN against this threat
- Vessel under almost constant surveillance
- Red conducted overt sonar scan of seabed in vicinity of cables
- Red inserted a second SOV, unobserved to the East
- Deployed UUV which performed a successful “hack” on the intra island network
- LFE:
- *wide area surveillance,*
- *passive sonar capability versus vessels of interest by non-specialist assets*
- *“beware of the obvious”*



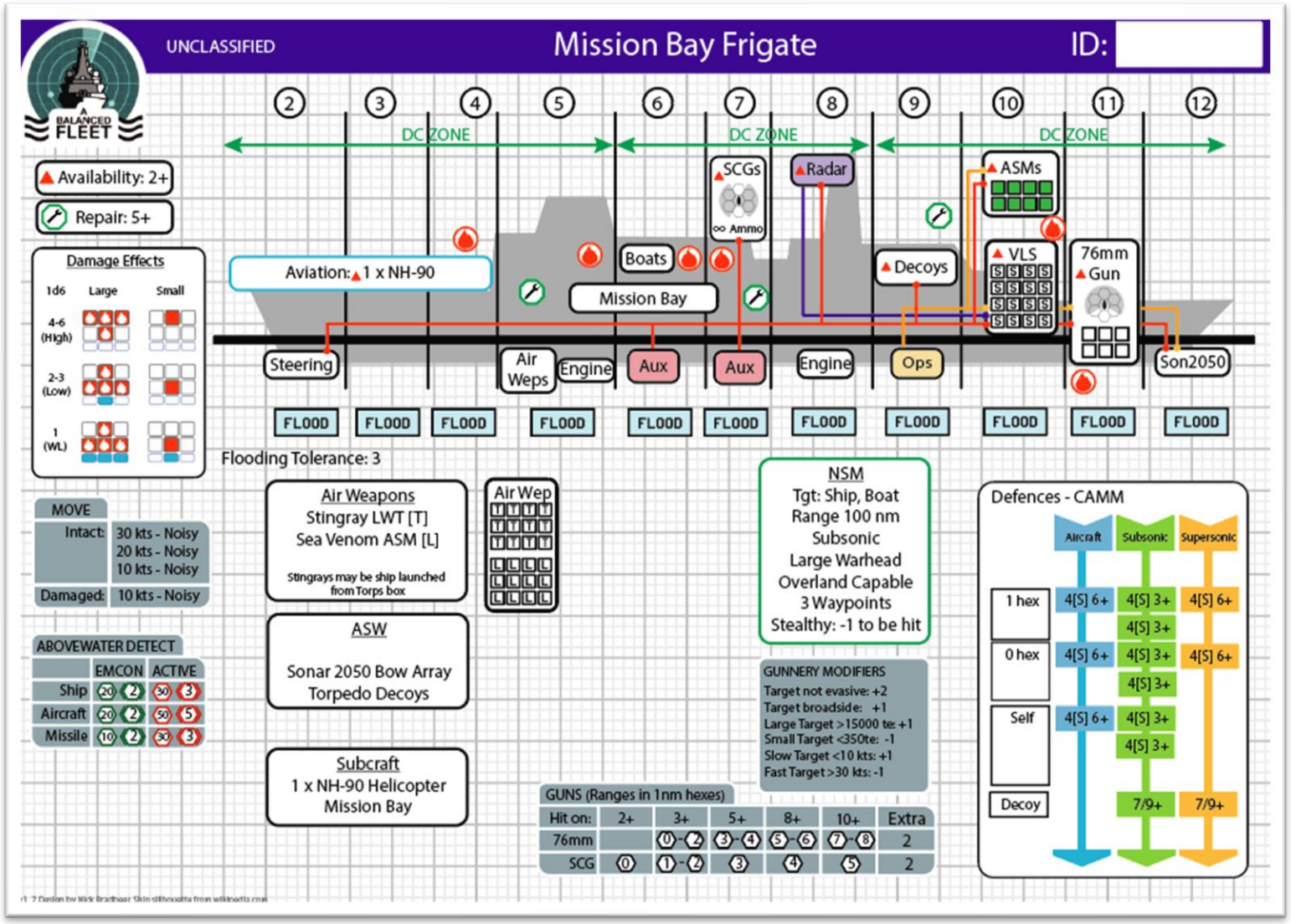
Game Data Architecture





	A	B	C	D	E	F	G	H	I	J	K
1	Obsvr Size	Large	Large		Horizon to Target Alt		48.1	km			
2	Radar Type	1	LJG-346B		Radar Detect Target Sig		131.35	km			
3	Combat Sys	6A	6A		Target Detected At:		48.1	km			
4	Reaction Time	12	s								
5	KA Time	5	s								
6											
7				Bus Spd	Sep Rng	Trm Spd	Flight	Terminal	Bandit	Bandit	
8				m/s	m	m/s	Profile	Mnvr km	Signature	Sig Mod	
9	ASCM Type	2	GENERIC BUS-BOOST	300	20,372	807	Vlow	0	VSmall	-1	
10											
11				Min Rng	Max Rng	ATA	Tgts/Dir	Msl/Tgt	Min Alt	Spd	
12				m	m					m/s	
13	SAM Type	9	CAMM	900	25,000	2.5	4	2	VLow	1,030	
14											
	Detection Range		48,100	m							
	Raid spd @ Detection		300	m/s							
	Reaction time		12	s							
	Engagement Range		44,500								
19	Max SAM Kinematic Range		32,282	m							
20	Raid range at first SAM launc		32,282	m							
21											
22	Timestep	2	seconds		Hex Size	10	nm				
23											
24	**Range (hexes)**				**2**	**1**	**1**				
25	**Targets**				**4**	**4**	**4**				
26	**pHit**				**0.80**	**0.60**	**0.60**				
27	**d10 Roll**				**3+**	**5+**	**5+**				
28											
29	SAM Launch times			(seconds)	0	31	51	63	69	155	1
30	SAM Salvo ID				1	2	3	4	5	6	
31	Max Range SAM reaches	m			26780	16480	8240	2060	0	0	
32	Impact Time	s			26	46	58	64	150	150	1
33	Raid Range at Launch	m			32,280	23,280	12,180	2,460	-	-	-
34	Raid Speed at Intercept	m/s			300	810	810	810	-	-	-
35	Raid Range at Intercept	m			24,480	15,420	5,700	840	-	-	-
36	VALID SHOT Y/N				1	1	1	-	-	-	-
37											
38	Target Size Mod				-1.0	-1.0	-1.0				
39	CS Gen Mod				1.5	1.5	1.5				
40	Seaskimmer Mod				0.0	0.0	0.0				

Ship Sheets, Capability Cards

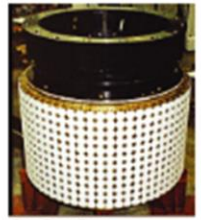


SONAR 2050 — PASSIVE MODE

HULL MOUNTED SONAR

ARCS

90%	60%	30%
0-2	3	4



DETECT (Use TN from template, modified as below:)

Target in shallow water:	+4
Target moving at 10 kts:	-3
Target detected last turn:	+2
Poor Weather:	See weather card

CLASSIFY (Use modified TN from Detect phase)

<= TN+1: Identified accurately (individual unit)
<= TN+2: Ship/Sub/Bio, Nationality, Propulsion
<= TN+3: Ship/Sub/Bio
> TN+3: No Information

LOCALISE

	On Detection	Detection +1	Detection +2	Detection +3
0-2 hex	Good			
3-4 hex	Fair	→ Good		
5-6 hex	Poor	→ Good		
7-10 hex	Poor	→ Fair	→ Good	
11+ hex	Poor	→ Poor	→ Fair	→ Good