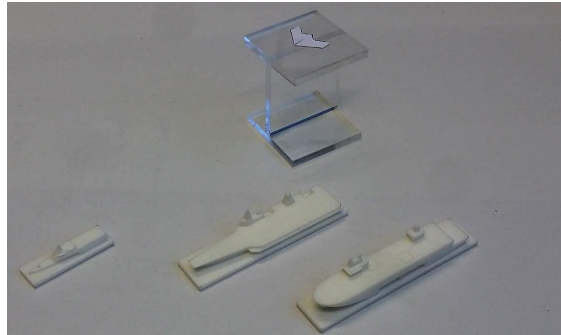


The Application of Wargaming to Education in Naval Design & Survivability



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Good morning.

- I'm Nick Bradbeer; I lecture in naval architecture – warship design – at UCL, although I work for the MoD.
- My co-author is David Manley, the ships section head within my parent MoD group – the Naval Authority Group.

Going to be talking about how we've used wargaming as a teaching tool within UCL's MoD-supported courses in naval platform design.

Naval Architecture at UCL



UCL has a small NA&ME cell, supported by the MoD. Prof Savage and I are both MoD employees, although we draw on other university staff.

We teach masters courses in naval architecture and marine engineering, and a short course in submarine design & acquisition

Many of our students come from the naval domain, so we're interested in teaching warship and naval submarine design.

But many of our students are MechEng grads with little or nil naval domain experience – and this showed in them making bad ship design decisions.

Objectives

- Teach domain context
- Assess military effectiveness of design options
- Teach design for vulnerability reduction

- Domain context for modern naval warfare. Ranges, speeds, interplay of weapons and defences. Importance of recce, target ID, air.
- Assess the effectiveness of designs. Both to allow students to explore options early during the trade process, and to assess final designs
- Also, to teach how to design for survivability. This just handily falls out, really.

We made some simple OA tools, but the information-centric nature really meant we needed wargaming. So we made some wargames.

Required Game Characteristics

- Capture the impact of NavArch design decisions
 - Layout
 - Mast height
 - Machinery / auxiliaries / system runs
 - Damage tolerance: damaged stability, DC zoning
- Fast to play
- Easy to pick up
- Fun enough to engage students

We need the game to capture the impact of Nav Arch decisions, but we also want it to be as fast as possible to play, as easy as possible to pick up and remain fun enough that students – who won't be wargamers, stay engaged.

Drives us towards a game which goes into a lot of detail in some areas, and wildly abstracts everything that doesn't relate to a NavArch design decision. (Missiles are missiles, etc)

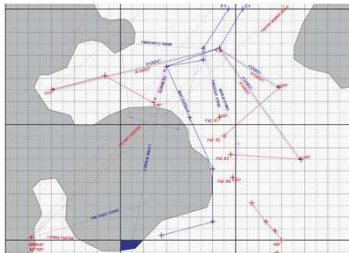
This game, as far as I could find, didn't exist. So I designed one.

Three Approaches

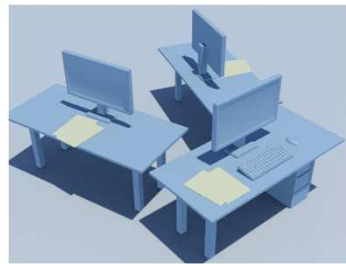


ASuW

ASuW On Paper



CROWS



I actually designed three.

- We have a miniatures-based wargame, ASuW.
- A map-based version of that; ASuW On Paper
- A computerised game, CROWS

We use all of these at UCL, for different things.

ASuW (A Simple UCL Wargame)



ASuW is our “largest” game. Mostly used for “Tactics Night” – a social event at the end of the ship design exercise where the teams get to put their designs to use, with beer and pizza.

We turn a classroom into a 3 x 4m game space – 300 x 400 nautical miles.

It’s a triple blind game – RED / WHITE / BLUE

Students – BLUE – have miniatures on the floor. Each player controls one ship, or some aircraft.

RED and WHITE have maps and sit behind screens.

Rules based for movement, detection and weapon effects – to allow consistency

Some adjudication for political complications

1 hour turns – typically get through ~6 in an evening.

ASuW – Ship Control Sheet

SNAME Tactics Night

ATHENA class FRIGATE Controller: _____

Air: 1 x Wildcat ID#: _____

DC ZONE 3 4 5 6 7 8 9 10 11 12

Equipment: Helicopter, Decoys, RAM, Radar, ESM, Exocet, Fwd CMM, Gun, Steering, Sonar, 3.6 MW, 30 MW, 8 MW, AUX, AUX, AUX

	Land	Sea	Air (Hi)	Air (Lo)	AUV (Hi)	UAV (Lo)
Visual	5	15	5	5	2	2
Radar	-	24	50	20	20	20

ESM Yes – detect hostile radar up to twice that radar's Sea detection range

Knots	MW
25	41
23	38
8	3.6
4	0

Towed array: <10 knots, detection range 20nm
100%@10+, 70%@4-10, 40%@1-3, 10%@0

ASMs	Range	Ammo
Exocet	80	8 OOOO OOOO

GUNS	Range (Surf)	Salvo size	To hit	Salvos vs Air	To hit	Ammo
76mm Gun	7	2	8+	4, 2	8+	40 OOOO OOOO OOOO OOOO OOOO OOOO OOOO OOOO OOOO OOOO

Flooding Tolerance: 3 Compartments

DEFENSES	Salvo Ranges	Dice / Salvo	Hit	Ammo
CAMM	12, 6, 4, 2	2	4+	12+12 (f) OOOOOO OOOOOO (a) OOOOOO OOOOOO
RAM	5, 3	2	3+	10 OOOOOO OOOO
Decoys	Yes: p(ASM Hit) = 7+ / If lost, p(ASM Hit) = 3+			

Each ship has a control sheet like this. Detailed!

Charts for detection ranges, speed with available power, and weapons.

When ships get damaged, the damage knocks out locations, damaging equipment or supply runs.

Fires in every DC zone, or underwater damage in too many WT compartments, and the ship is lost.

ASuW - Movement




Movement very simple – ships simply move up to 1cm per knot of speed.

Land units a bit more complicated since they may have to pack down / set up, but basically the same.

Aircraft can fly recce missions – either pick a route and fly it, or AEW aircraft sit on station for several turns.

ASuW - Detection



	Land	Sea	Air (Hi)	Air (Lo)	AUV (Hi)	UAV (Lo)
Visual	5	15	5	5	2	2
Radar	-	24	50	20	20	20
ESM	Yes – detect hostile radar up to twice that radar's Sea detection range					

Detection is automatic – if target in range, will be detected. (Exception for ASW sonar, where there is a secret die roll)

Mast height is important, since it determines radar horizon vs sea and low air targets

ESM detection means EMCON is important.

Maps reconciled by umpires – would like to automate in future.

Contact markers placed on radar/ESM hit, or miniatures on visual. WHITE force makes ID important.

ASuW – Air Ops

Strike

- Mission Radius: 100nm
- Attack Range: 10nm
- Weapons: 2 x ASM

Recce

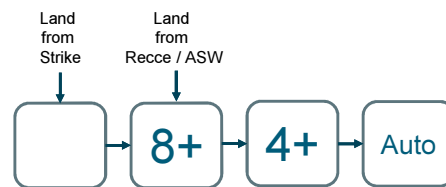
- Mission Radius: 100nm

ASW

- Mission Radius: 100nm
- Detection Radius: 10nm
- 100%@10+, 70%@4-10, 40%@1-3, 10%@0
- Weapons: 2 x Torpedo (7+)



	Land	Sea	Air (Hi)	Air (Lo)	AUV (Hi)	UAV (Lo)
Visual	5	20	5	5	2	2
Radar	-	15	15	15	7	7
ESM	Yes – detect hostile radar up to twice that radar's Air detection range					



Aside from recce missions, aircraft can perform some of Naval Strike, Land Attack or ASW missions.

All missions complete within a turn.

After attacking, they return to a maintenance track – can launch early at the risk of loss.

Maybe unrealistic timings, but captures the need to balance alpha with sustained strike rate

ASuW – Weapons Fire

DEFENSES	Salvo Ranges	Dice / Salvo	Hit	Ammo
CAMM	12, 6, 4, 2	2	4+	12+12 (f) 000000 000000 (a) 000000 000000
RAM	5, 3	2	3+	10 000000 0000
Decoys	Yes: p(ASM Hit) = 7+ / If lost, p(ASM Hit) = 3+			

- Captures missile speed, control channels & pK
- CIWS mitigates damage
- Decoys/Jammers determine p(Hit)

Weapons very abstracted. ASMs are either “subsonic” or “supersonic”

Defensive fire model based on a number of defensive salvos at varied ranges with a die roll for each potential intercept. (The EMCON trap)

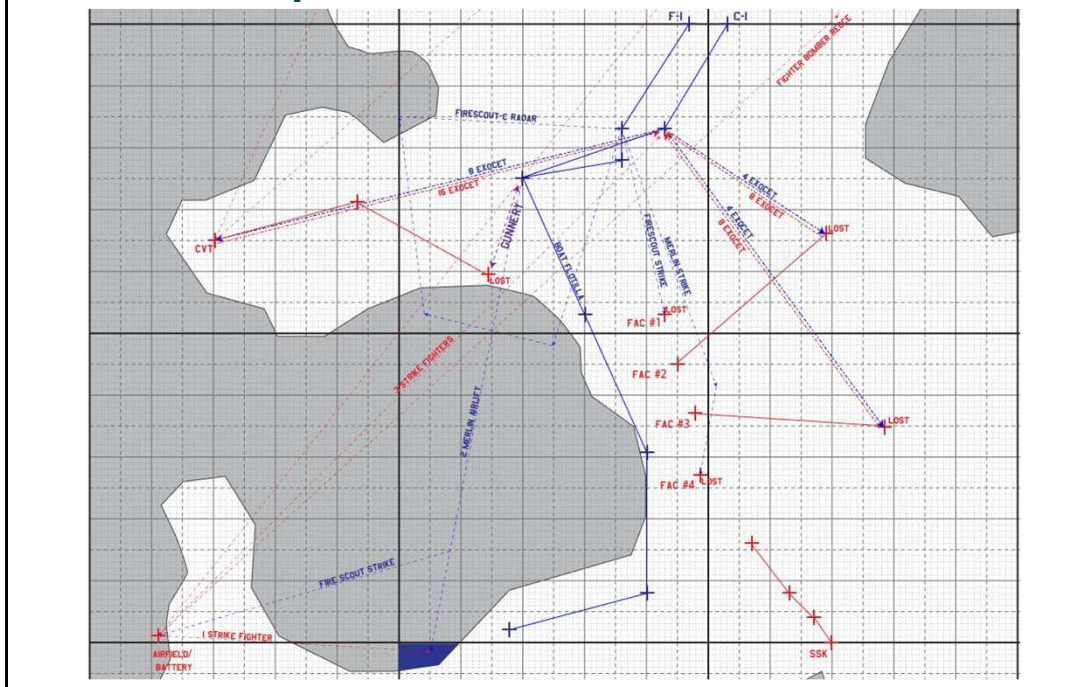
This model based on a pre-calced Time Domain Simulation code.

CIWS degrades missile damage

Jammers & Decoys determine p(Hit)

Hits either smash one compartment, or one plus all adjacent.

ASuW On Paper



ASuW on Paper

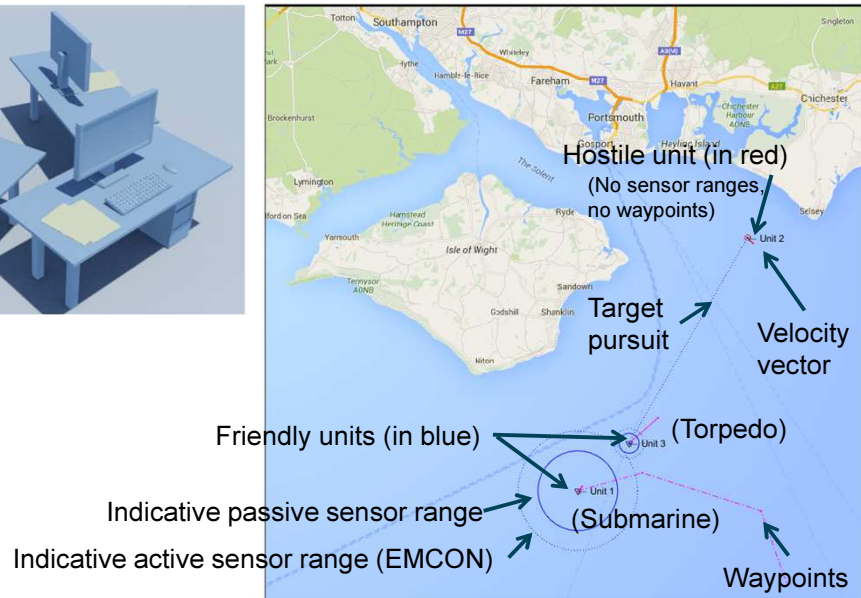
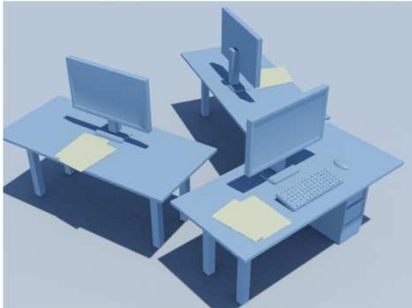
Instead of a floor, both sides use large paper maps (A1)

Same rule system, but makes adjudication easier and massively reduces setup time.

Suitable for early stage concept exploration.

Notably reduced student engagement! It's less fun!

CROWS – Computerised Rapid Options Wargaming System



Software approach intended to make things faster

One computer, multiple monitors.

Automates detection, and cycles through small timesteps until new information appears for either player.

Very fast – mostly used for SMDX where can cycle through several scenarios in an hour and we rarely care about weapon damage effects

Submarine easy to define – Speed, battery energy, quieting measures, sonar size, armament

Useful tool, but students don't really enjoy it nearly as much as Tactics Night – feels more like work.

Conclusions

- Wargaming brought a noticeable improvement in quality of warship design decisions.
- Physical floorgaming much more engaging; slower to play but holds students' interest much better
- War crimes

Better warships – sensible VLS sizes, reasonable top speeds, lots of unmanned air.

Having the physicality of 3d printed models moving around a floor is surprisingly helpful with student engagement.

Last two years' Tactics Nights ended in student war crimes – UCL Laws have offered to lend us Intl Law students as command advisors....