

Future Warship Design

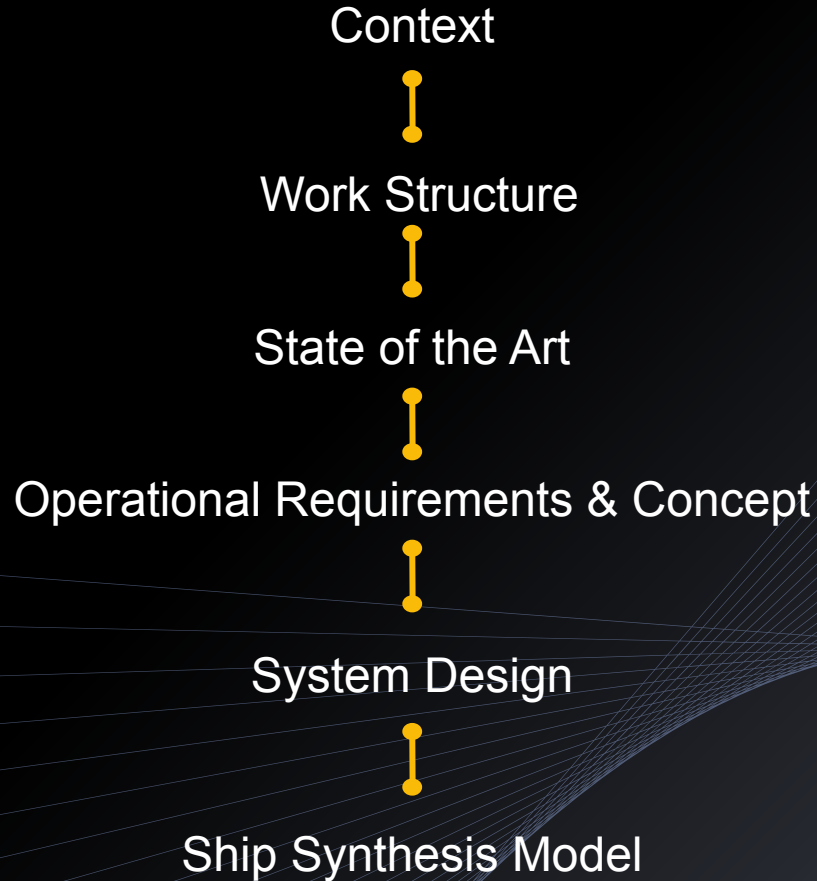
Concept Design Overview for a Multi-Mission
Drone Carrier Warship



1.

Introduction & Agenda

Agenda



2.

Context



2. Context



2.
Context



The Guardian

2.
Context

Sevastopol Naval Base: Admiral Makarov Frigate & Mi-8/17
Helicopter

October 29 2022

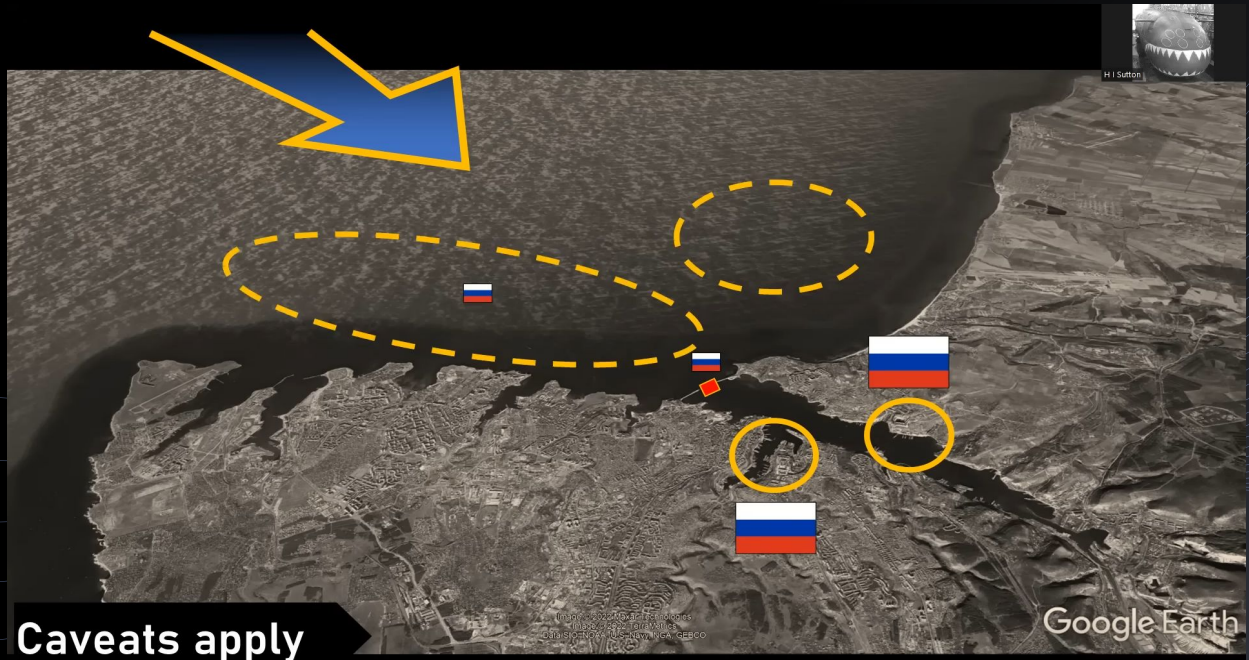
29 ЖОВТНЯ 2



Covert Shores

2. Context

2 Main Anchorage Areas: Frigates & Submarines

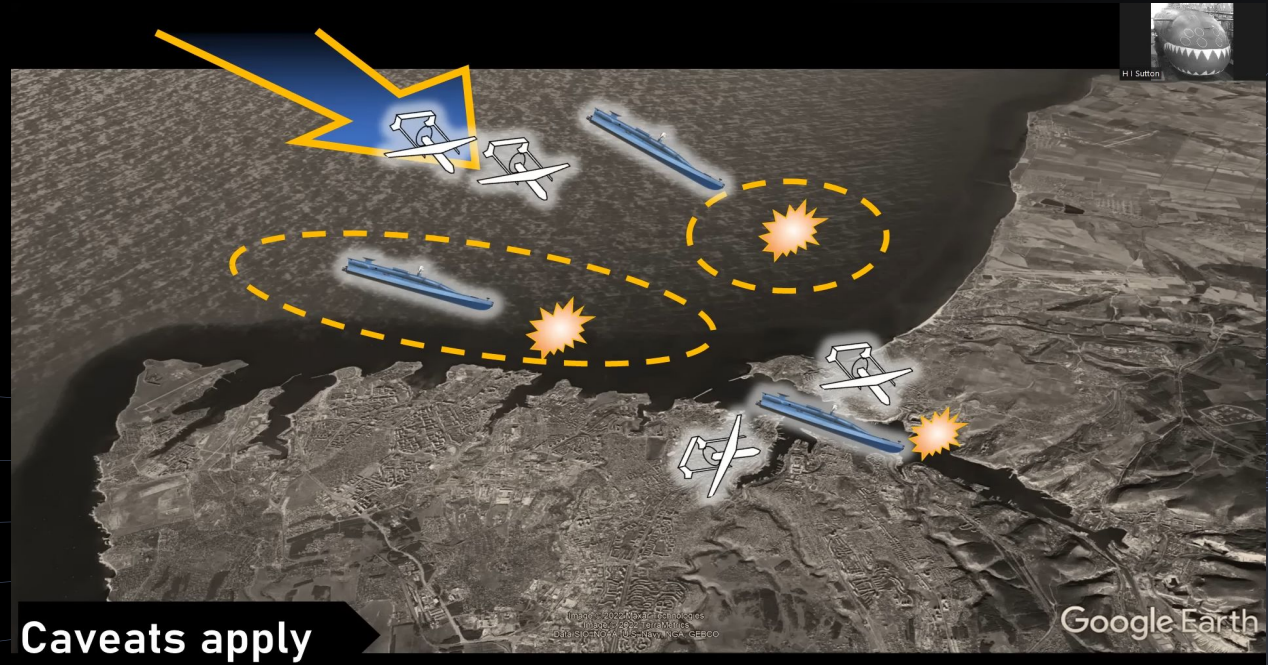


Caveats apply

Covert Shores

2. Context

UAV [9] & USV [7] Combined Attack

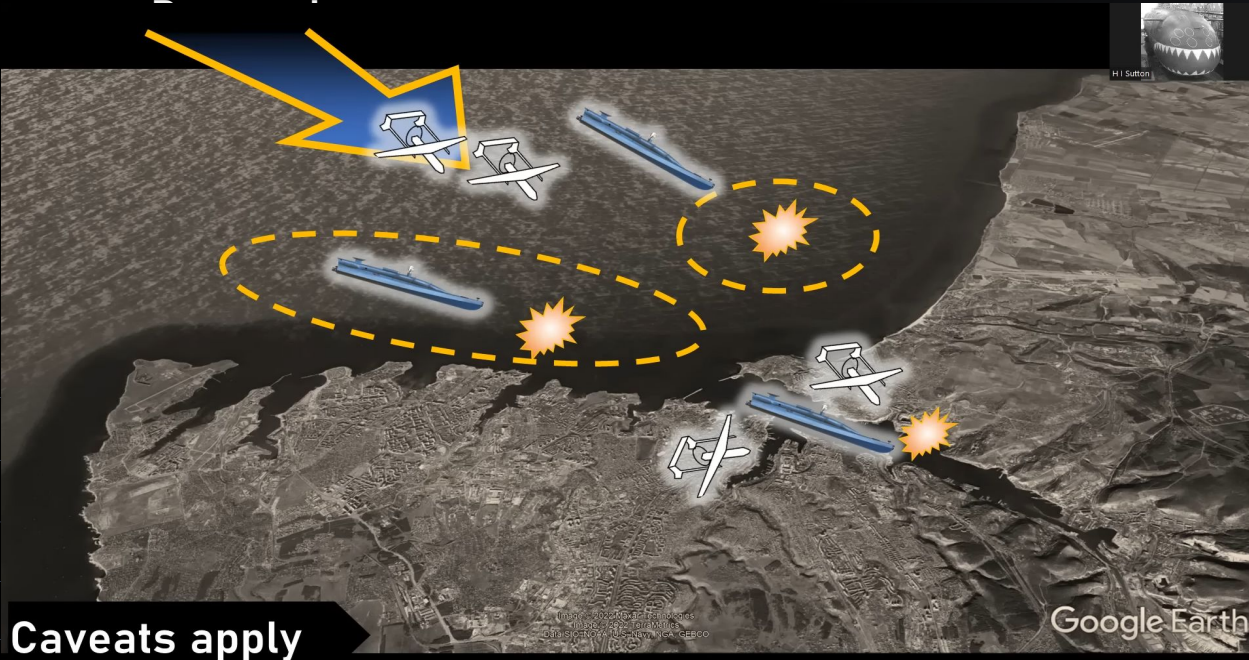


Caveats apply

Covert Shores

2. Context

2 Damaged Warships: Frigate & Minesweeper
Service Vessel and Dam infrastructure also



Caveats apply

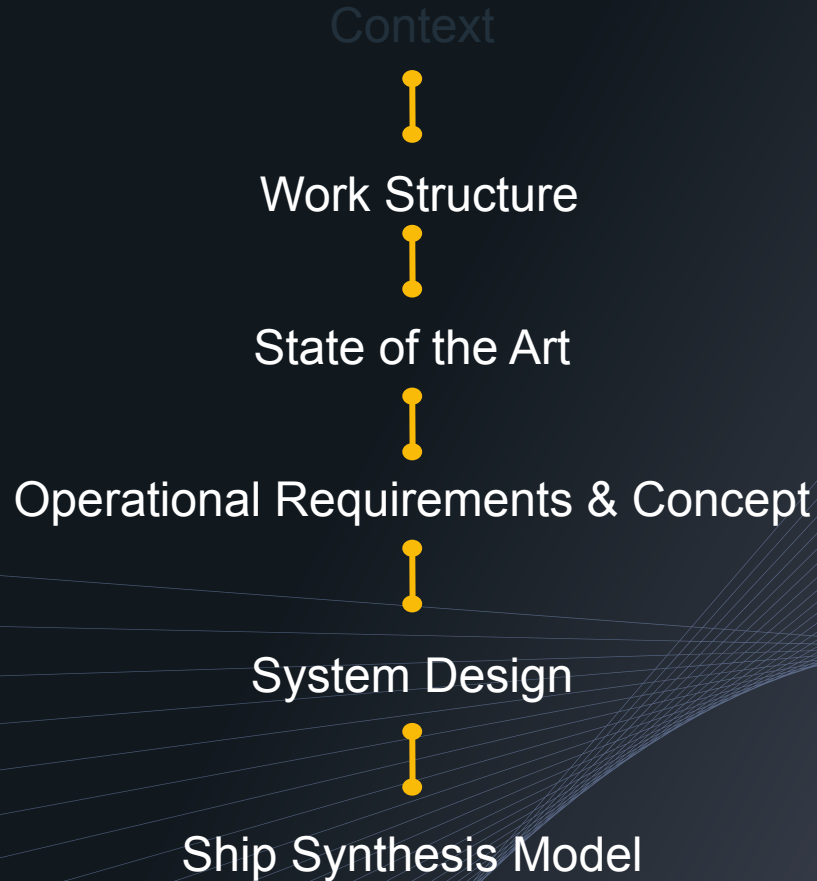
Covert Shores

2.

Context



Agenda

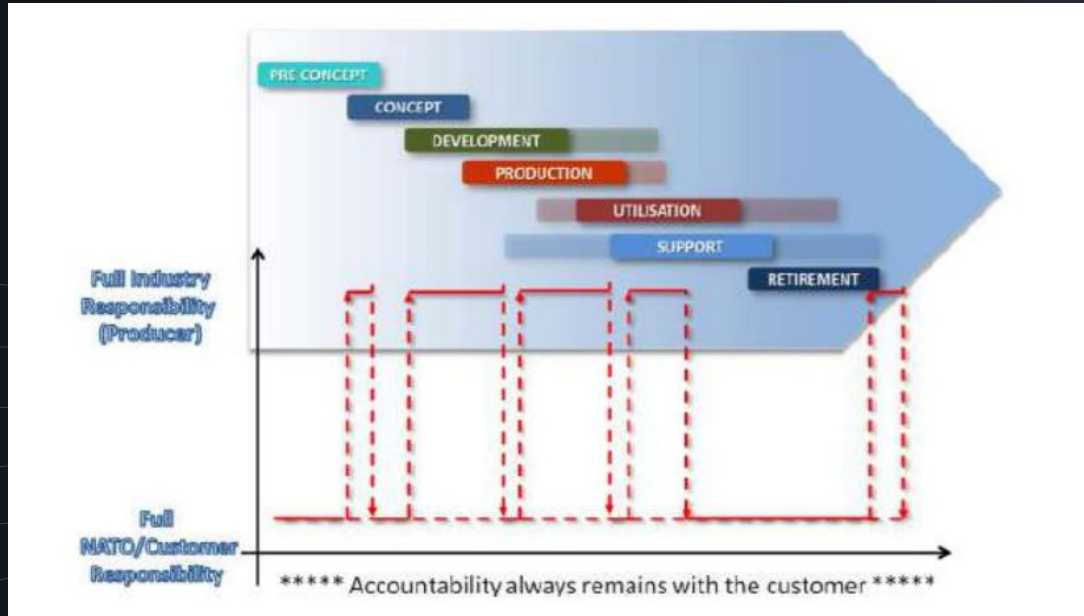


3.

Work Structure

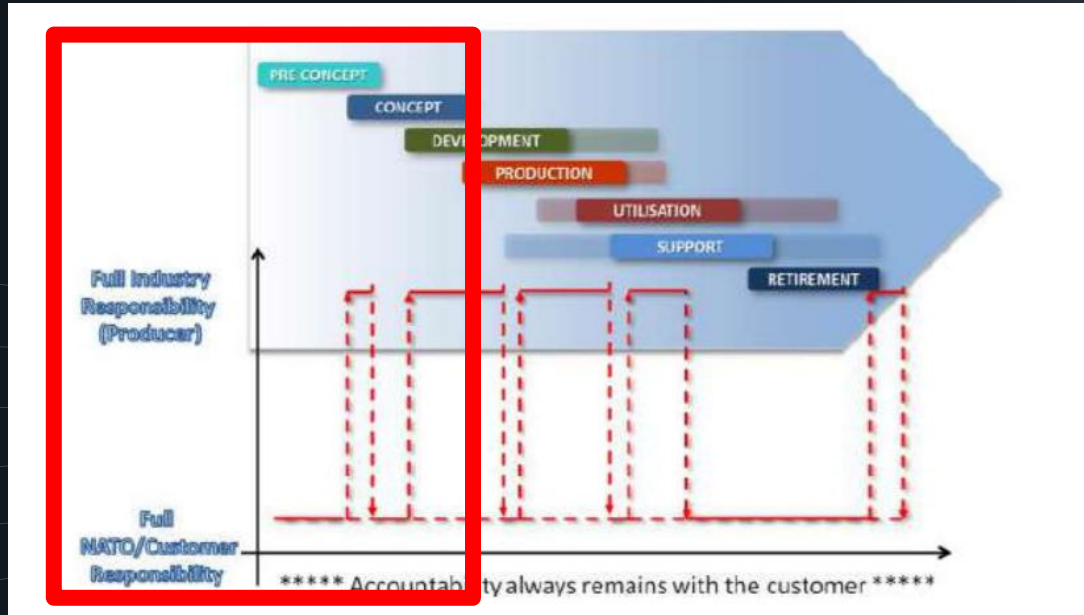
3. Work Structure

NATO AAP-20: NATO Programme Management Framework



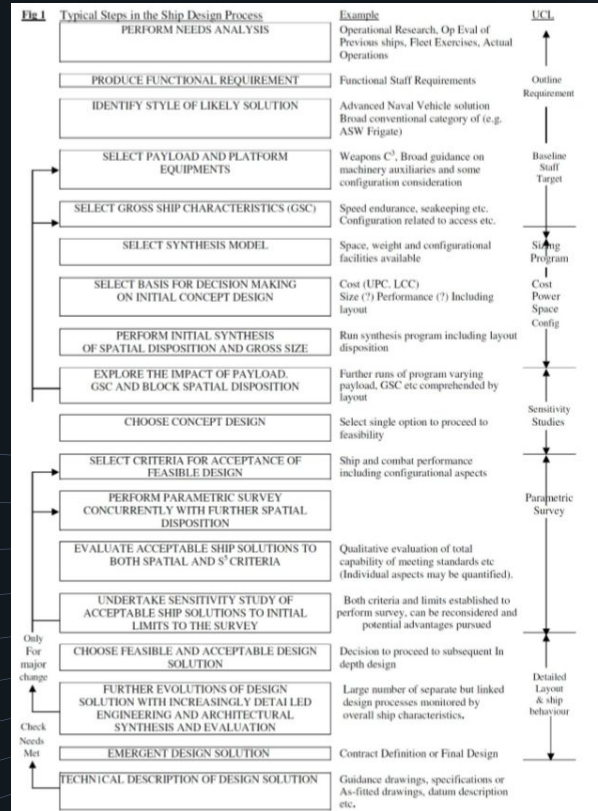
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NATO AAP-20: NATO Programme Management Framework



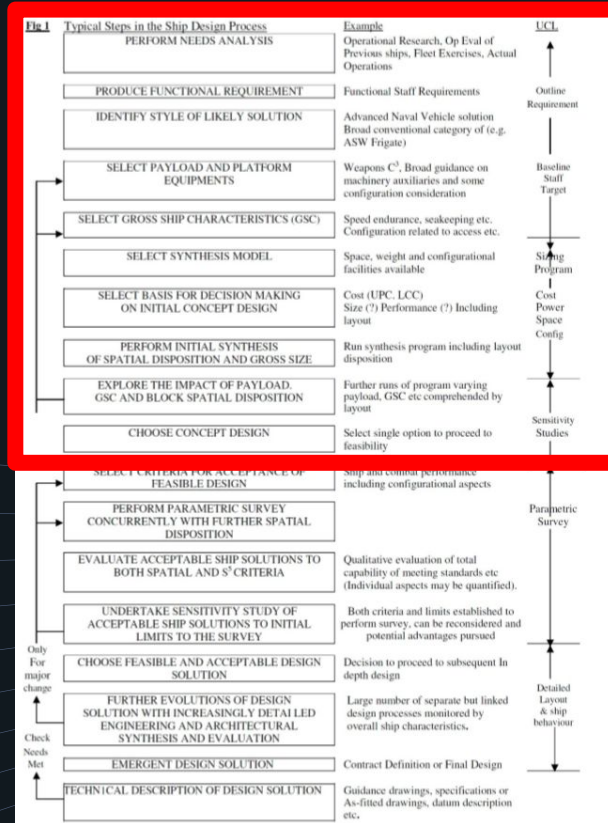
3. Work Structure

University College London & RN Procedures

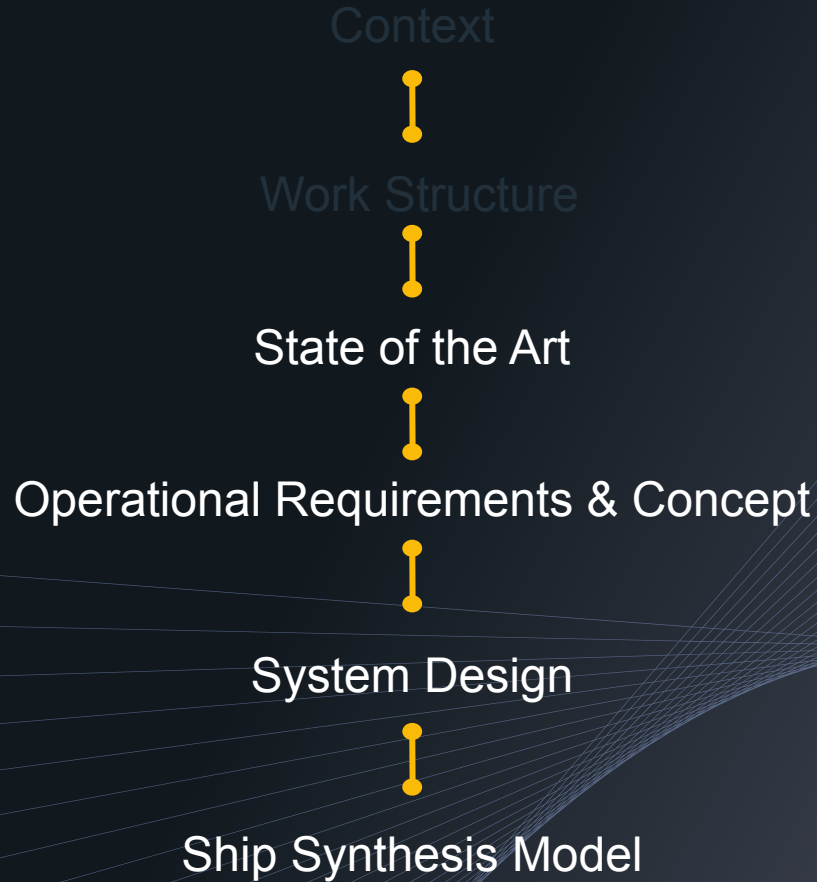


3. Work Structure

University College London & RN Procedures



Agenda



4.

State of the Art

The background features a dark blue gradient with a series of thin, white, curved lines that originate from the right side and fan out towards the left, creating a sense of motion and depth.

4.

State of the Art



- Zhu Hai Yun (PLA Navy);
- TCG Anadolu (Turkish Navy);
- Drone carrier concept vessel (PoN);
- UXV Combatant (BAE Systems);
- Octopoda 500 (Mauric);

4.

State of the Art



- Key Notes & Takeaways;
- Operational use context;

Agenda

Context



Work Structure



State of the Art



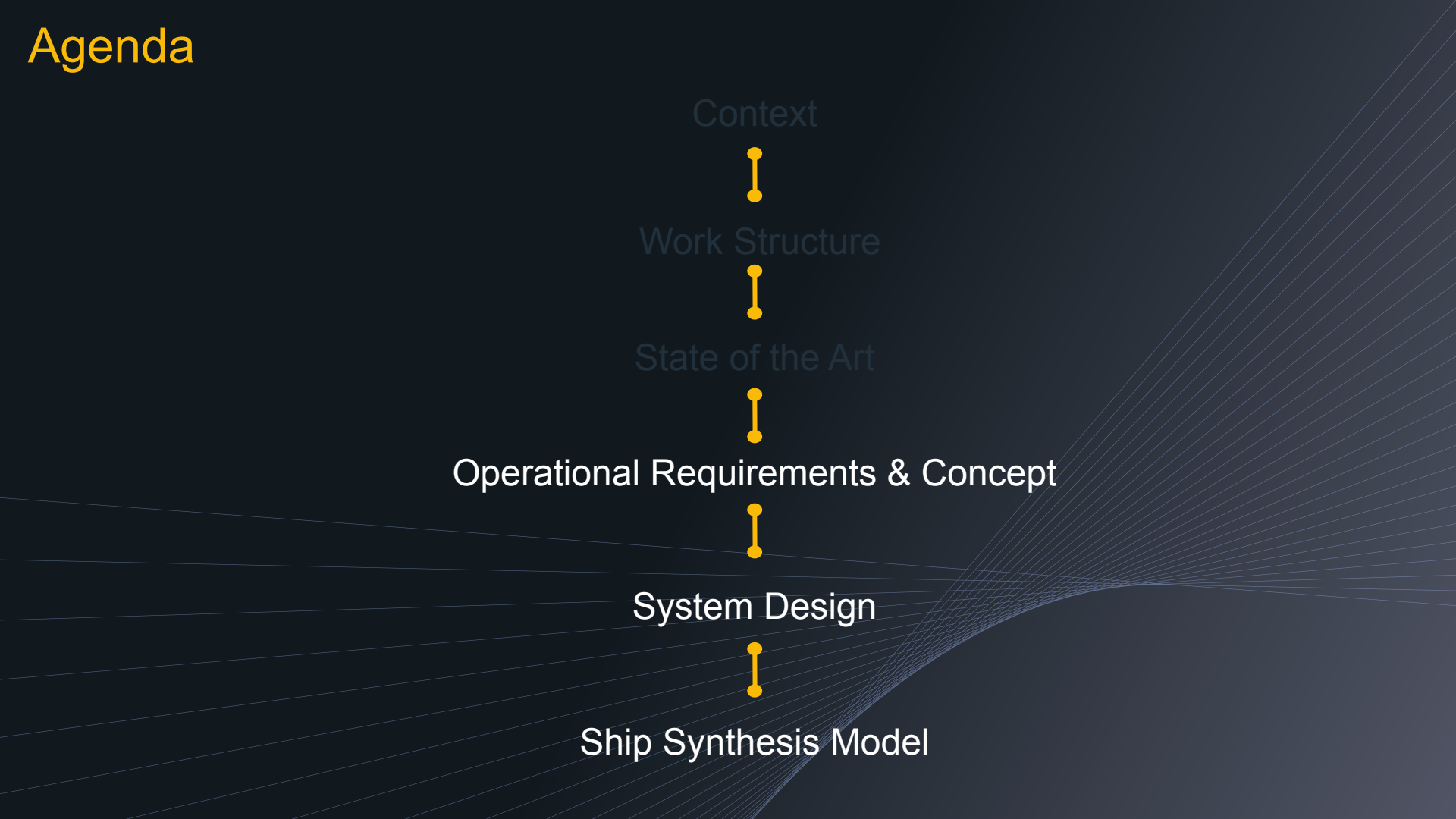
Operational Requirements & Concept



System Design



Ship Synthesis Model



5.

Operational Concept & Requirements

5.

Operational Concept Development

4 Key-Questions:

“What Market sector will the solution be aimed at?”

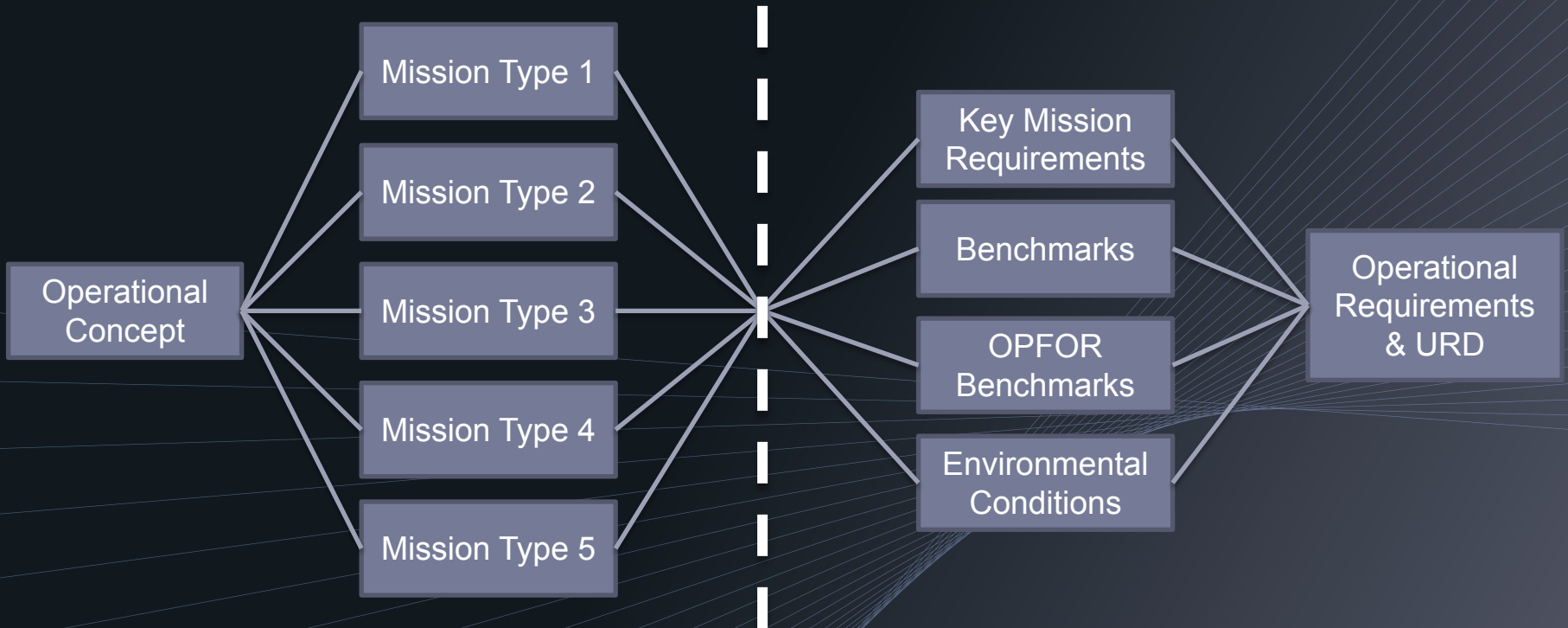
“What areas will the ship operate in?”

“In what context will it operate in?”

“How will the concept solution’s success be measured?”

5. Operational Concept Development

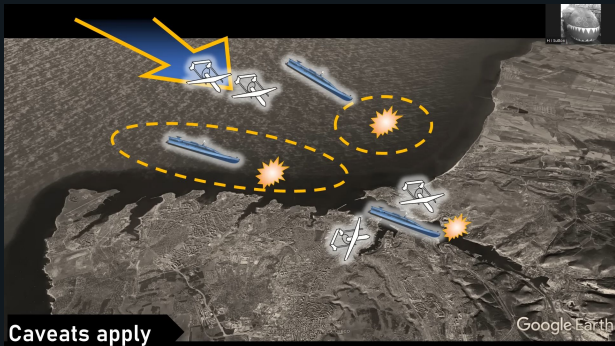
The process:



5.

Mission Type 1: Example

Coastal & Infrastructure Strike Operations



Area of Operations



Tuo-Chiang Class



Visby Class



5.

Mission Type 1: Example

Coastal & Infrastructure Strike Operations



OPFOR Benchmarks

- Udaloy Class Destroyers
- Admiral Gorshkov Class Frigates
- Admiral Grigorovich Class Frigates;
- Neustrashimyy Class Frigates;
- Buyan-M Class Corvettes;
- Karakurt Class Corvettes;
- Steregushchiy Class Corvettes;
- Project 22160 Class Patrol Ships;
- Grachonok Class Patrol Boats;
- Raptor Class Patrol Boats;
- Kilo Class Submarines;
- K-300P Bastion-P coastal defence system;
- A-222E Bereg-E 130mm coastal mobile artillery system;
- 9M133 Kornet portable guided missile system;
- Sukhoi Su-24 bombers;
- Tupolev Tu-22M bomber;
- Mikoyan MiG-29 fighter aircraft;
- Various mines using Soviet Fra technology;

5.

Mission Type 1: Example

Coastal & Infrastructure Strike Operations

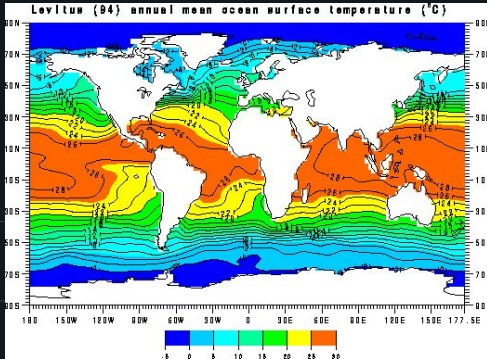


- Maximum Speed: 35 knots;
- Protective countermeasures and CUAVs and/or VLS missile systems capable of effectively countering small patrol boats (Range >5,500 metres);
- Composite material hull to minimise magnetic signature and reduce the threats of mines;
- Carry USVs capable of performing ASW reconnaissance and deploying countermeasures;
- Radar and threat detection systems with a range of over 300 km;
- Deploy and retrieve USV, UAV and manned vessels at a minimum distance of 150 km from shore;
- Carry manned craft to transport special operation forces to and from shore (2 teams of 12 operators);
- Carry a minimum of 5 long range reconnaissance UAVs supplemented by 6 long range CUAVs;
- Carry up to 10 USVs designed to carry explosive payloads between 50 and 200 kg;
- CHAFF and decoy countermeasures for missile defence purposes;
- Deploy up to 2 medium to large MM-USVs;
- Minimise both its radar cross section, acoustic and infrared detectability;

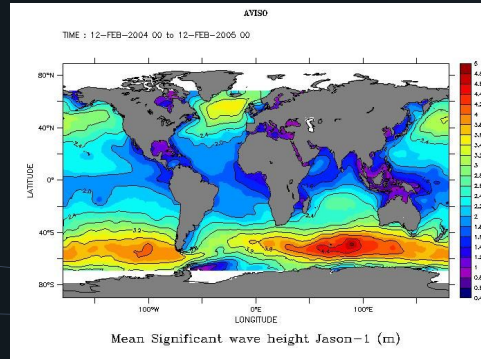
5. Area of Operations

North Atlantic

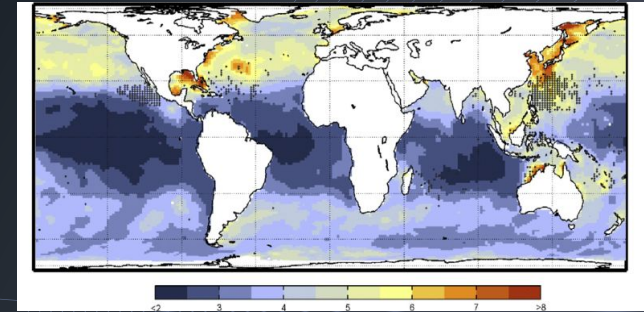
Surface Temperature



Significant Wave Height



Average Sea States

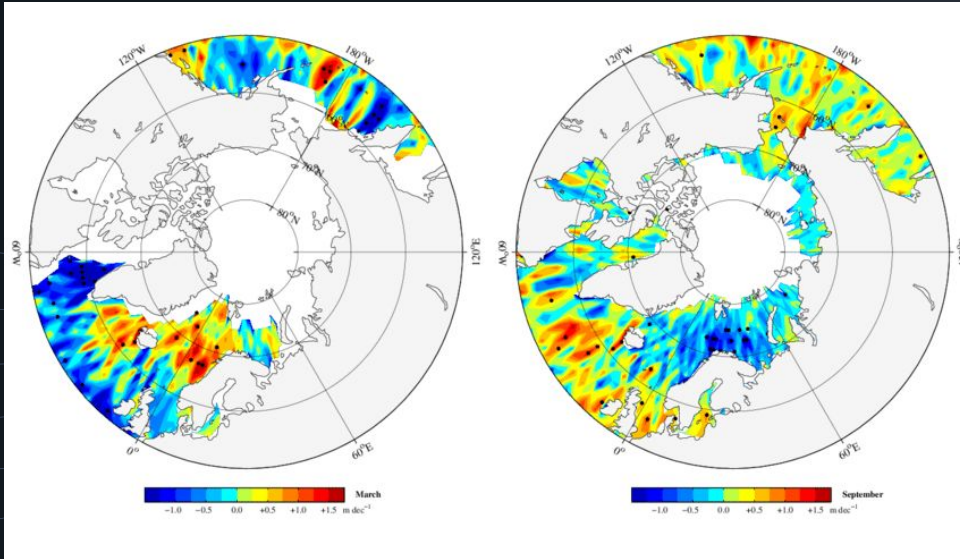


5.

Area of Operations

North Sea, Baltic, Arctic

Average Seasonal Surface Temperature

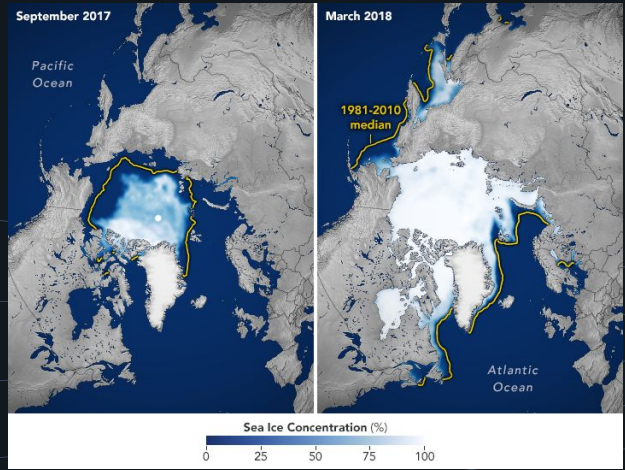


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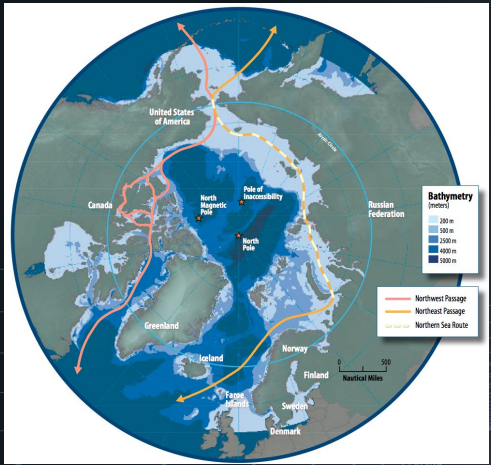
Area of Operations

North Sea, Baltic, Arctic

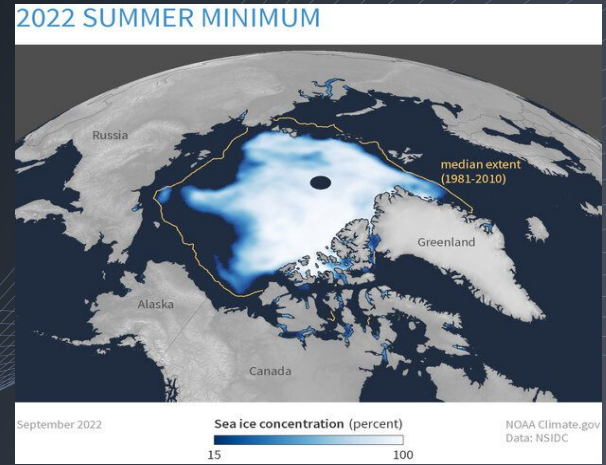
Polar ice cap seasonal changes



Arctic Navigation Pathways



Ice cap reduction (1981, 2010, 2022)

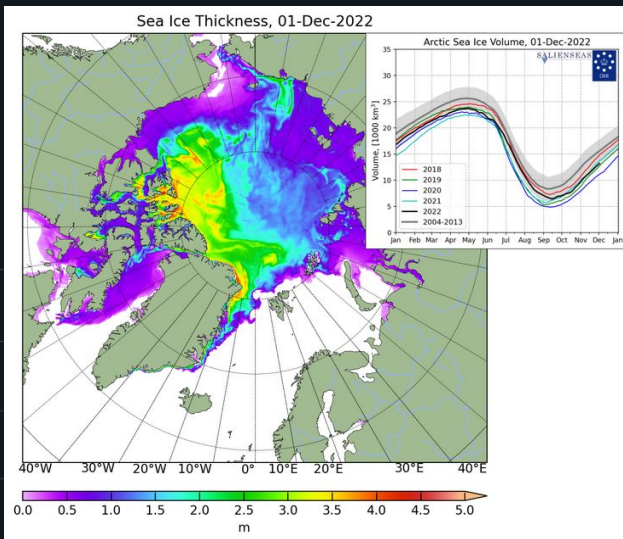


5.

Area of Operations

North Sea, Baltic, Arctic

Mean Ice Thickness (2022)



Main Takeaways:

- Unmanned systems temperature requirements;
- Topside Sensors & Effectors: ice & temperature requirements;
- IMO Polar code Ice class PC(7);
- DNV-RU-SHIP: Cold Climate ICE-C Class;
- Flight deck, bridge and auxiliary requirements;

5.

User Requirement Document (URD)

ANNEX ANNEX A: User Requirement Document (URD)

USER REQUIREMENT DOCUMENT (URD) DRONE CARRIER CONCEPT DESIGN

1. MISSION

- a. Drone carrier ship, designed to carry various payloads of organic unmanned vehicles in order to perform operations individually, outside of a conventional task force, or integrated into a naval task force within a support role.
- b. Standard missions for the vessel will include:
 - i. Territorial water reconnaissance & patrol;
 - ii. Humanitarian relief in crisis events;
 - iii. Infrastructure and coastal raiding operations;
 - iv. Task force unmanned systems support;

2. CONSTRAINTS / INITIAL DESIGN DECISIONS

- a. Minimize production costs and consider robust systems that don't require high maintenance costs;
- b. Minimize thermal, acoustic and radar signatures;
- c. Mission availability of a minimum of 300 days per year;
- d. Capacity to operate in sea states up to four in the Douglas scale and wind conditions of five in the Beaufort scale.
- e. Maximum draft of 8 meters (limits set considering the naval port of Den Helder);
- f. Maximum length of 200 meters (limits set considering the naval port of Den Helder);
- g. The ship should have CODLAG propulsion;
- h. The ship should be able to organically integrate unmanned aerial, surface and underwater vehicles;
- i. VTOH launch and retrieval capabilities should be assured through the use of a flight deck;
- j. A well dock with a moon pool will be used to deploy all surface and underwater vehicles;
- k. Hull extrusions, including superstructure, should be minimized in order to reduce radar signature;
- l. The ship should be able to operate in cold climate conditions and in water with floating ice (Arctic Ocean, Baltic and North Sea) considering a Polar class classification of E or above;

3. PRIMARY TASKS

- a. Territorial water reconnaissance and patrol missions, including boarding operations within the context of vessel and small craft inspection operations;
- b. Search and rescue operations;
- c. Coastal infrastructure raiding operations]

4. SECONDARY TASKS

- a. Task force support;
- b. Naval presence;
- c. Supporting economic and scientific research activities within the vessel's area of operations;
- d. Crisis response and humanitarian aid missions;

5. OPERATIONAL AREA

- a. North Atlantic Ocean;
- b. Norwegian, North, Barents, Baltic and Kara Seas;
- c. Arctic Ocean (select missions);

6. AUTONOMY AND LOGISTICS

- a. Capable of sailing during 20 days at a speed of 16 knots;
- b. Capable of sailing during 8 hours at a maximum speed of 35 knots;
- c. Supply autonomy for 30 days, considering normal operating crew sizes;
- d. Capable of resupplying at any port of commercial terminal used by NATO navies within its area of operations;
- e. Capable of supplying emergency medical services on board, considering integrated combat infirmary and operating room facilities;
- f. Capable of performing VERTREP operations;
- g. Capable of receiving and processing floating logistic packages through the use of its well dock;

7. CREW

- a. The amount of personnel needed to operate the ship as well as its systems should be minimized;
- b. The ship should be able to accommodate extra crewmembers depending on the assigned mission (including special operations teams, divers, border control agents, police and homeland security teams);
- c. Capable of accommodating up to 50 distressed personnel or migrants up to 30 hours on board;

8. RELIABILITY AND MAINTENANCE

- a. The ship's maintenance concept should be focused on maintainability at sea, as the ship will have long sailing periods without coming to port;
- b. Regular dockings and preventive maintenance based at shore should be accounted for however, in order to ensure adequate system maintenance;
- c. The propulsion system as well as rescue craft systems should be reliable enough, or redundancies should be ensured, in order not to compromise critical mission success in the case of rescue at sea operations or crisis response missions;

9. SYSTEM USAGE

- a. Life cycle: ship designed for a life cycle of 30 years;]

- Defined main ship operational and technical requirements on the final user's end;
- Will serve as reference for final concept adequacy evaluation;
- Guideline for system selection and initial design decisions;
- Base-line restrictions set for ship synthesis model & initial sizing;
- Definition of operational capability metrics for design evaluation;

Agenda

Context



Work Structure



State of the Art



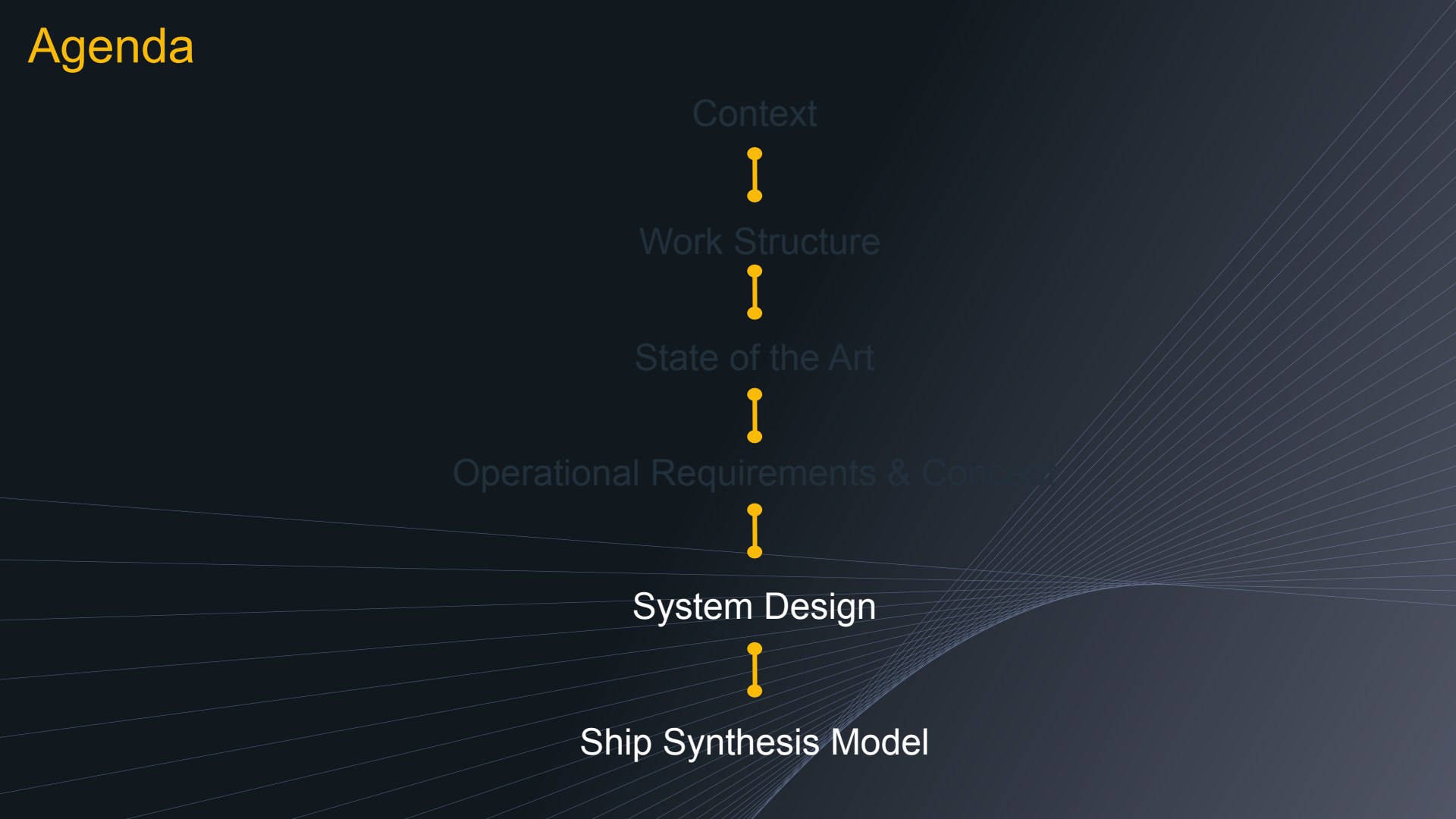
Operational Requirements & Concepts



System Design



Ship Synthesis Model

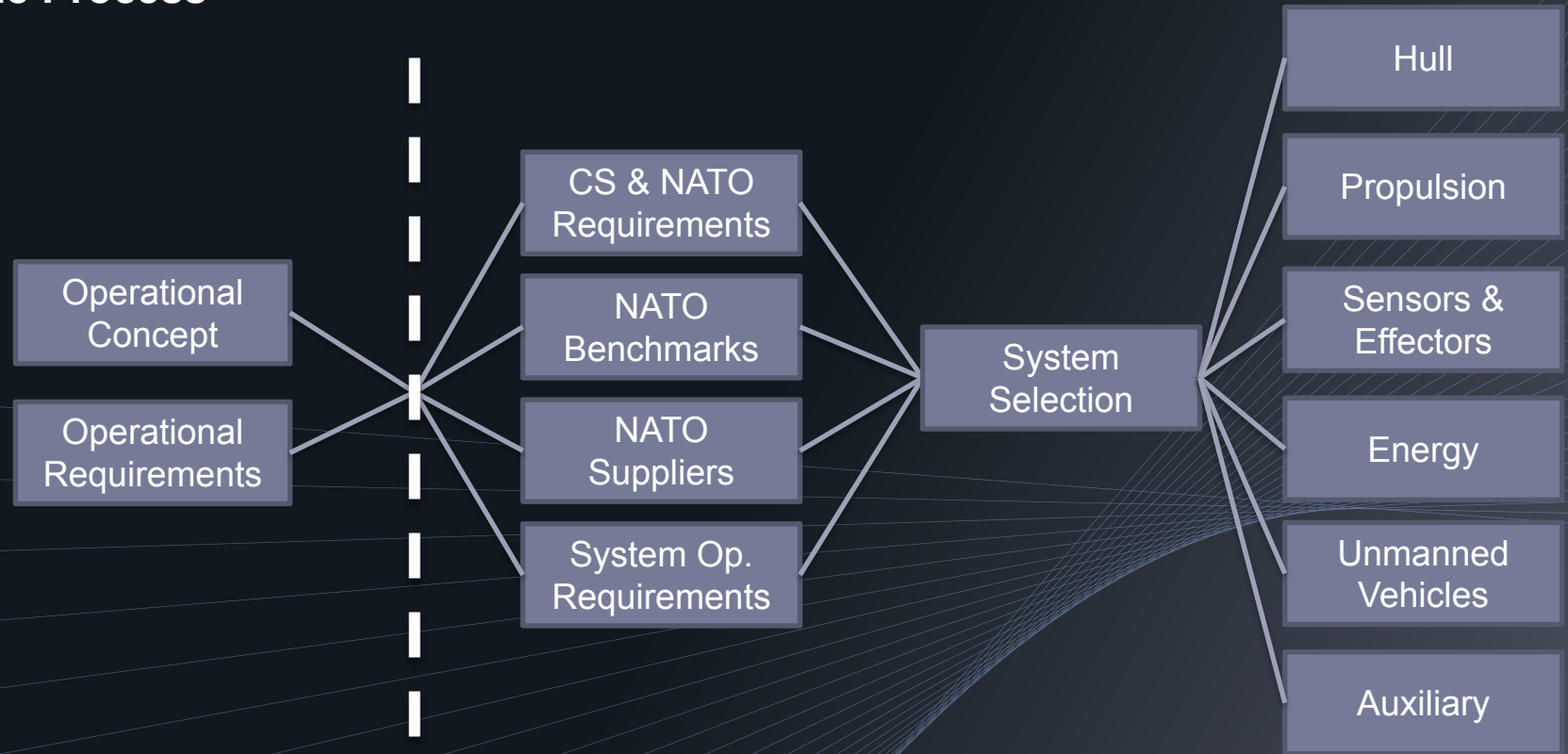


6.

System Selection

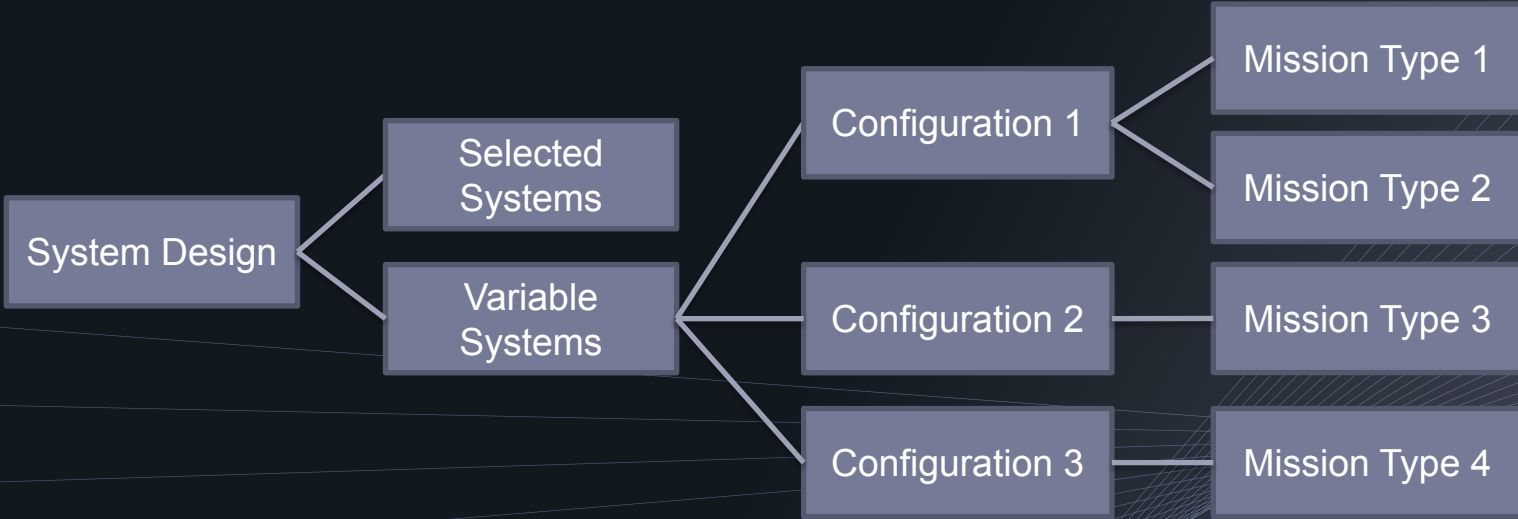
6. System Selection

The Process



6. System Selection

The Process



6. System Selection

Example: Hull



- Available well dock space (5)
- Arctic water viability (5)
- Speed (4)
- Acquisition Costs (3)
- Deck Space (3)
- Stability (3)
- Maintainability & Reliability (2)
- Manoeuverability (1)

Hull Type	Available Well Dock Space	Arctic Water Viability	Speed	Acquisition Costs	Deck Space	Stability	Reliability	Manoeuverability	Average
Monohull	5	5	3	5	3	3	5	3	4.15
SWATH	0	3	4	2	5	5	2	1	2.77
Catamaran	1	2	5	4	5	5	3	2	3.27
Trimaran	4	3	5	3	4	4	4	4	3.85
Hydrofoil	4	1	5	1	3	2	2	5	2.77

6. System Selection

Example: Hull



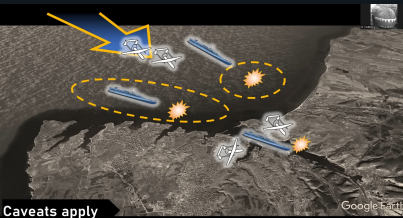
- Available well dock space (5)
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Trimaran	4	3	5	3	4	4	4	4	3.85
Hydrofoil	4	1	5	1	3	2	2	5	2.77

6. System Selection

Example: Unmanned Payload 1

Mission Scenario:
Coastal Raiding/Strike
With amphibious capabilities



Variable Payload Requirements:

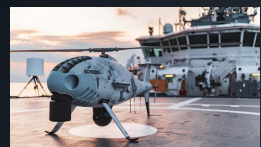
Zodiac MM RHIB [3]



Or: SDV [3]



UAV (Recon) [10]



UCAV [3]



UAV (Loitering) [60]



USV (Loitering) [20]

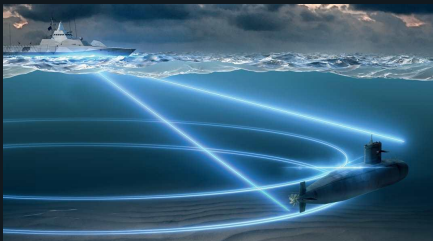


6.

System Selection

Example: Unmanned Payload 2

Mission Scenario:
ASW Task Force Support



Variable Payload Requirements:

Helicopter [1-2]



UAV (Recon) [10]



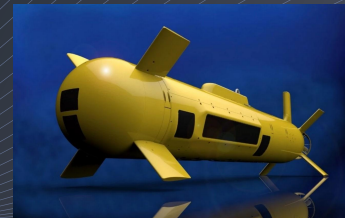
USV (MM) [2]



UUV (Loitering) [20]



UUV (MM) [2]



Agenda

Context



Work Structure



State of the Art



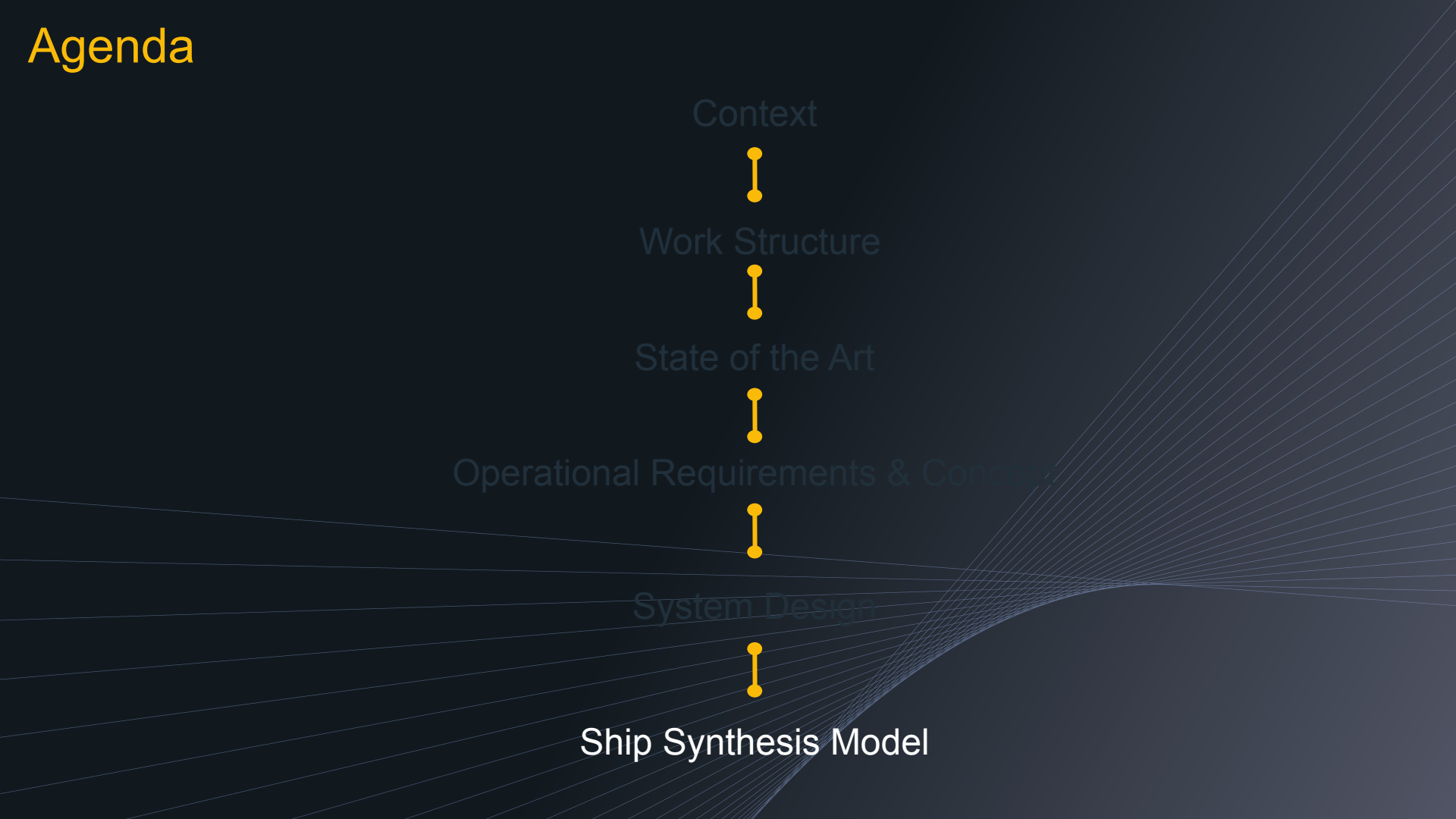
Operational Requirements & Concepts



System Design



Ship Synthesis Model



7.

Ship Synthesis Model

7.

Ship Synthesis Model

Inputs

Ship Main
Dimensions

Hull Form
Coefficients

Ship Synthesis Model

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graph LR; A[Ship Main Dimensions] --> B[Ship Synthesis Model]; C[Hull Form Coefficients] --> B; B --> D[Output Area]
```


7.

Ship Synthesis Model



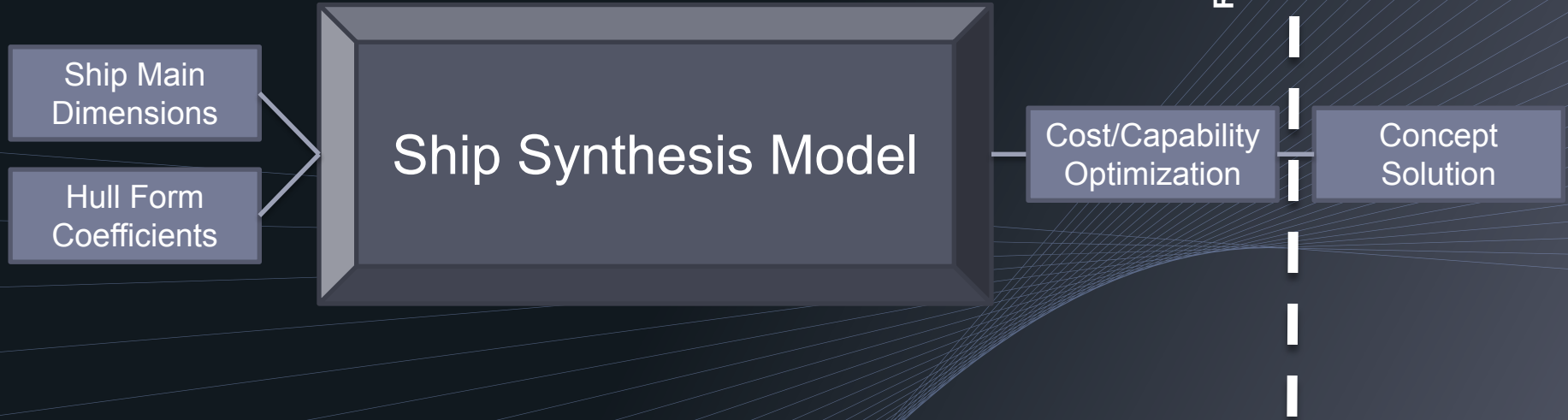
Ship Synthesis Model

7.

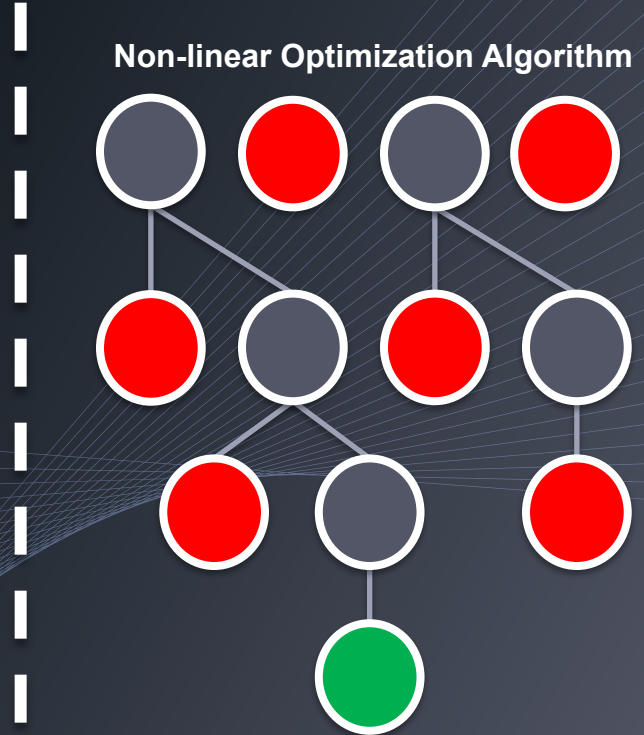
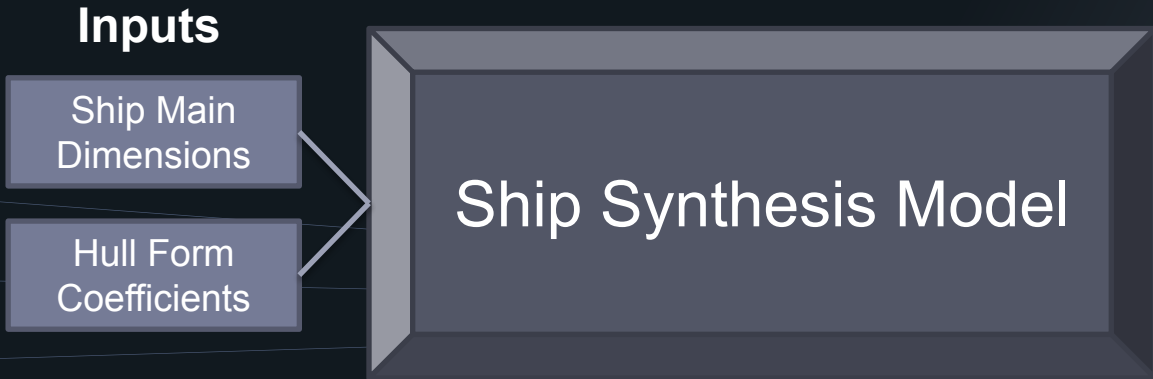
Ship Synthesis Model

Resistance & Propulsion	Weight Groups [SWBS Based]	Weight Distribution
Volume Distribution	Stability Calculations	Voyage / Operations Model
Endurance & Autonomy Calculations	Complement & Crew Calculations	Costing Model
Unmanned Payload & Systems Database	Cost/Capability Calculations	Naval Ship Database

7. Ship Synthesis Model



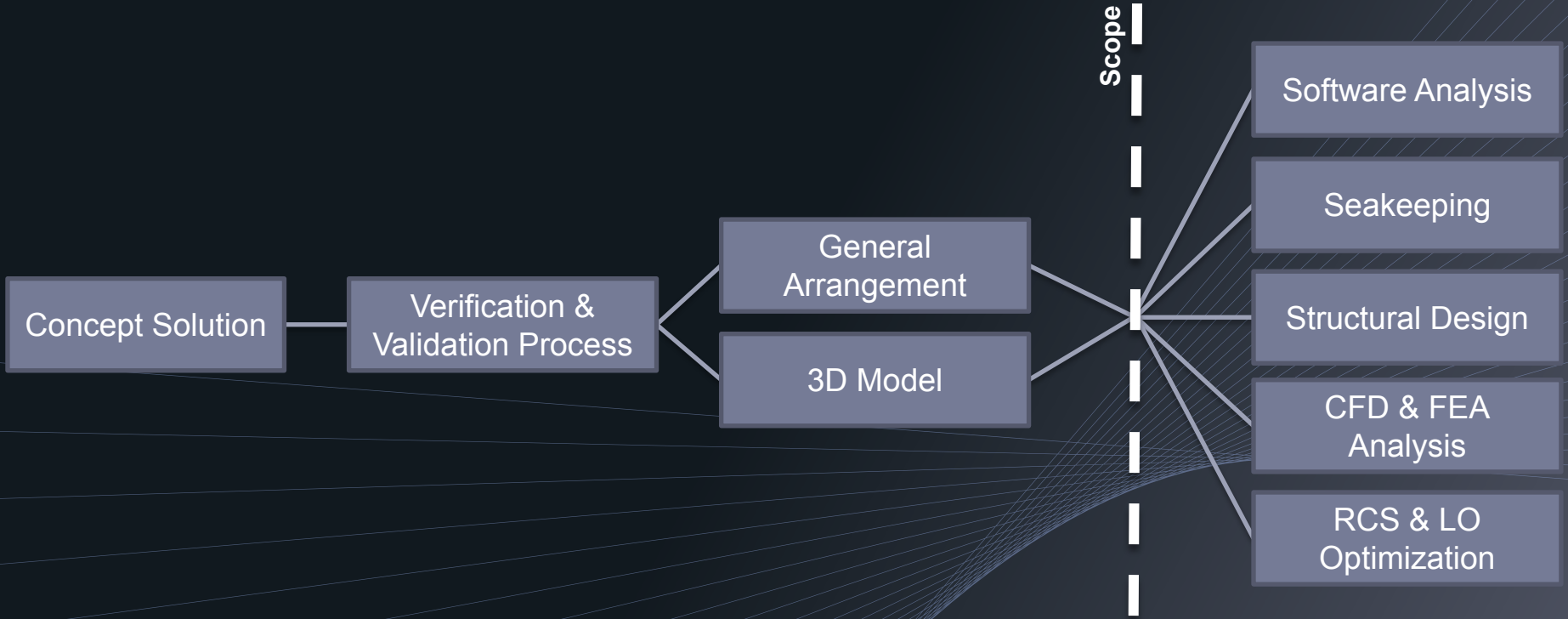
7. Ship Synthesis Model



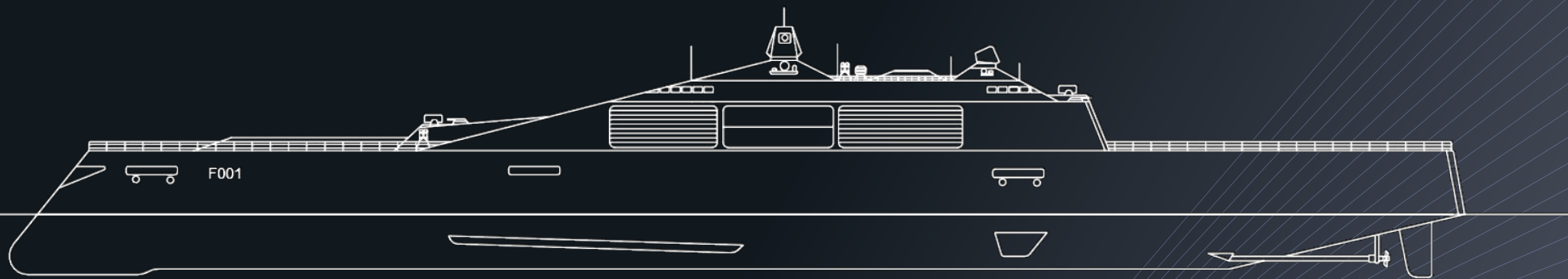
8.

The Ship

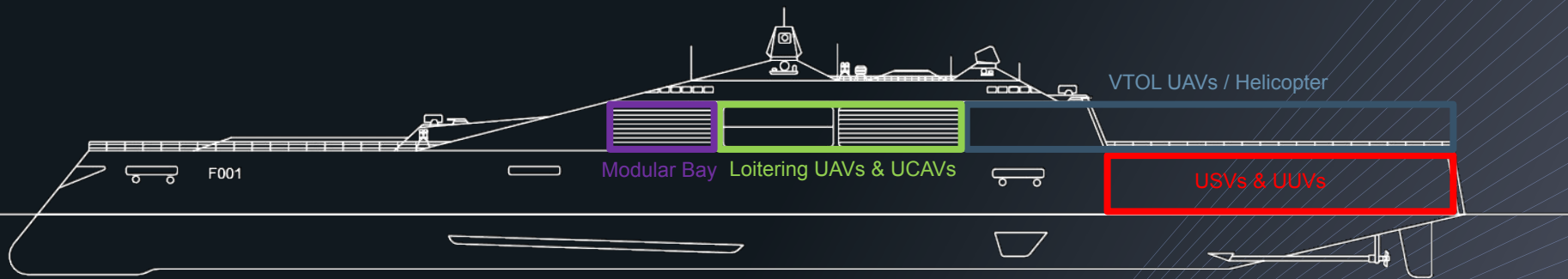
8. The Ship



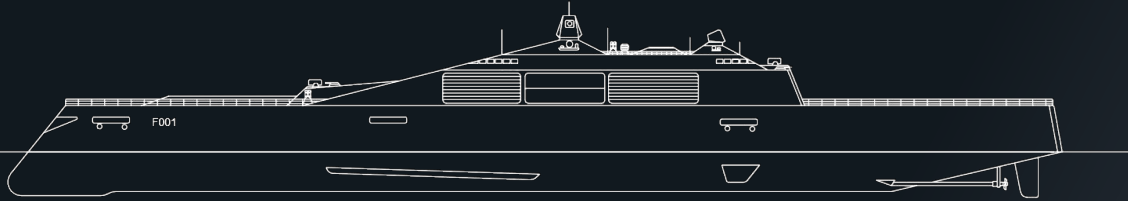
8.
The Ship



8. The Ship

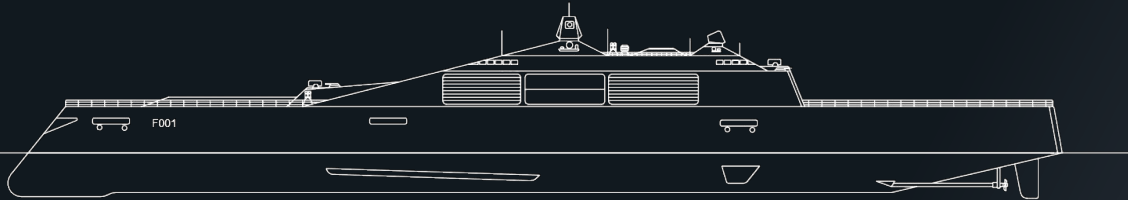


8. The Ship



Variable	Operational Requirements			Check
	Min	Obtained	Units	
Maximum Speed	35	35	knots	COMPLIANT
Service Speed	12	12	knots	COMPLIANT
Radar Coverage	1500	2400	nm ² /hour	COMPLIANT
Range	4000	6557	nm	COMPLIANT
USV Capacity (Peacetime)	2	2	EA	COMPLIANT
Self Defence Capability	Yes	Yes	Y/N	COMPLIANT
Missile System Range	5.5	50	km	COMPLIANT
UAV system range (Loitering)	22	250	km	COMPLIANT
UAV system range (UCAV)	150	250	km	COMPLIANT
Radar detection range	300	320	km	COMPLIANT
UCAV Range	150	3 941	km	COMPLIANT
Troop Transport Capability	24	32	PAX	COMPLIANT
Long range recon UAV #	5	15	EA	COMPLIANT
UCAV #	5	6	EA	COMPLIANT
Loitering Munitions USVs	10	252	EA	COMPLIANT
Decoy Countermeasures	Yes	Yes	Y/N	COMPLIANT
MM-USV #	2	2	EA	COMPLIANT
HERO-400EC	50	105	EA	COMPLIANT
HERO-900	40	84	EA	COMPLIANT
HERO-1250	30	63	EA	COMPLIANT
XQ Valkyrie	5	6	EA	COMPLIANT
Camcopter	4	15	EA	COMPLIANT
AR3 Tekever	10	24	EA	COMPLIANT
Propulsion Type	CODLAG	CODLAG		COMPLIANT
VLS modules	5	6	EA	COMPLIANT
Decoy System Suite	Yes	Yes	Y/N	COMPLIANT
Counter Unmanned	Yes	Yes	Y/N	COMPLIANT
Sonar	Yes	Yes	Y/N	COMPLIANT
Hangar	Yes	Yes	Y/N	COMPLIANT
Mission Bay	Yes	Yes	Y/N	COMPLIANT
Hull Type	Monohull	Monohull		COMPLIANT
Missile Cells	20	24		COMPLIANT

8. The Ship



Main Ship Details		
Variable	Units	Obtained
Length	m	159
Breadth	m	19
Depth	m	12
Draught	m	7
Displacement	t	8485
Cost	[M]US\$	557
Range	nm	6557
Service Speed	knots	12
Max. Speed	knots	35
Propulsion Type		CODLAG
Complement	PAX	225
UAV [Recon]	EA	39
UAV [Loitering]	EA	252
UAV [Combat]	EA	6
USV [MM]	EA	2
USV [loitering]	EA	35
RHIB	EA	2

9.

Something Special

Future Warship Design

Concept Design Overview for a Multi-Mission
Drone Carrier Warship

