

# A Review of the Future “Bomb Shop”

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A review of how the Future Weapons Stowage Compartment (WSC) could fundamentally affect the Capability and Affordability of tomorrow’s submarines .

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# The Future “Bomb Shop”

## Introduction

Our paper outlines:

- A definition & key design factors of a WSC
- Provide a brief history of WSC
- Review key technology drivers
- Conclude with an overview of WSC options for a future submarine.



Current in-service WSC

# Definition – Design Challenge

- The WSC on a submarine is the area where weapons are stored and prepared for discharge.
- The WSC is a fundamental part of the submarine design.
- **Key design factors include:**
  - Submarine size & operational function including stealth, stability, sensors and compensation tanks.
  - Payload type, size and weight
  - Crew safety
  - Munition's safety
  - Overall submarine complexity and affordability.



# 1900s – The first “Bomb Shop”

- HMS Holland 1 – First Submarine with a WSC
  - A single forward facing 18 inch (450mm) torpedo tube on the centreline
  - 3 torpedoes
  - Firing reload time?
  - No munitions safety features (shock, fire suppression)
  - Limited crew space and manual torpedo handling



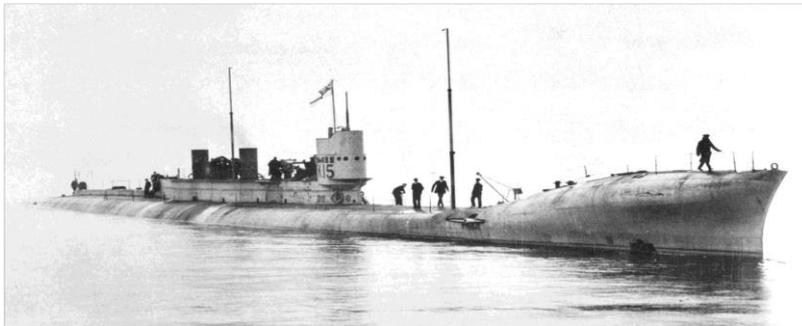
Picture Credit: Maritime Museum Portsmouth



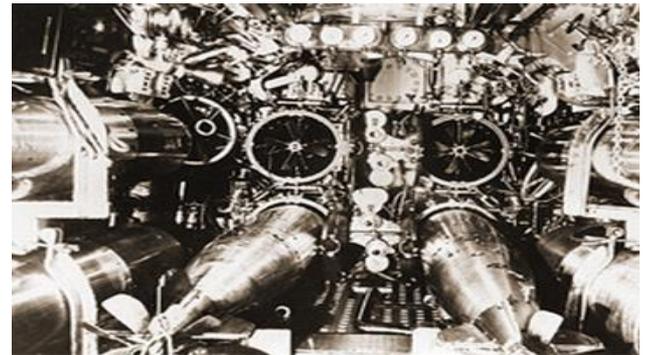
# 1910s – WW1 innovation

## Royal Navy K- Class – Dedicated WSC

- 4 x 18inch Torpedo Tubes in the Bow
- 4 x 18inch Torpedo Tubes Broadside
- 2 x 18inch trainable Torpedo Tubes in the Superstructure
- Firing Reload – ~30 minutes
- No munitions safety features (shock, fire suppression)
- Limited crew space and manual torpedo handling



Picture Credit: Covertshores



# 1940s – WWII Innovation

## Elektroboot U Boat Type –XXI – Mother of modern submarine

- Standardised 6 x 21-inch forward facing fixed torpedo tubes
- Accommodate 17 torpedoes in WSC
- Semi – mechanised loading
- Firing Reload – ~10 minutes
- No munitions safety features (shock, fire suppression)

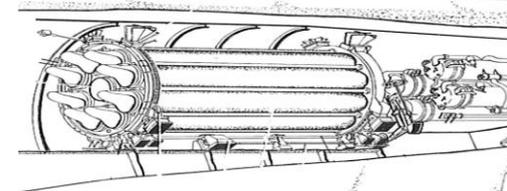
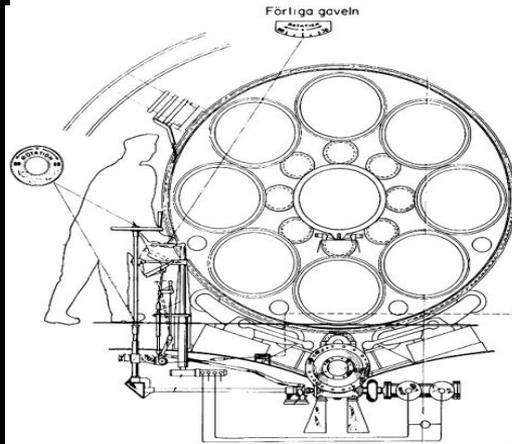


Picture Credit: Defensionem

# 1950s – Mechanical Innovation

## A10 Class – Novel designs

- Standardised 6 x 21-inch forward facing fixed torpedo tubes no reloads
- External 20 x 18inch revolving torpedo magazine
- Firing Reload – ~5 minutes for LWT

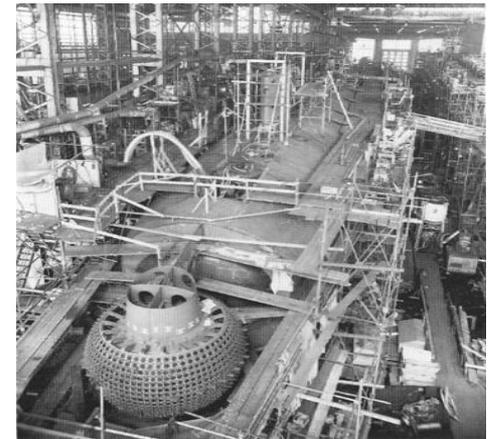
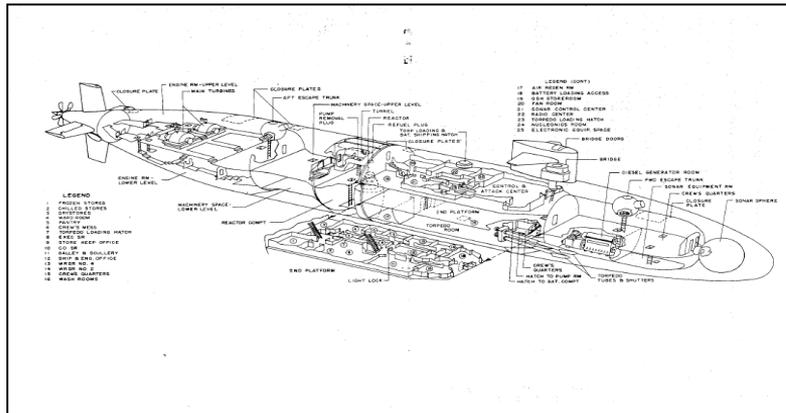


Picture Credit: Covertshores

# 1960s – Sonar Innovation

## Thresher SSN Class – Acoustic compromise

- Standardised 6 x 21-inch forward facing fixed torpedo tubes
- WSC further aft to allow large sonar array
- Torpedo Tubes fire outwards around the sonar
- Firing Reload – ~10 minutes



Picture Credit: NavSource Online: Submarine Photo Archive

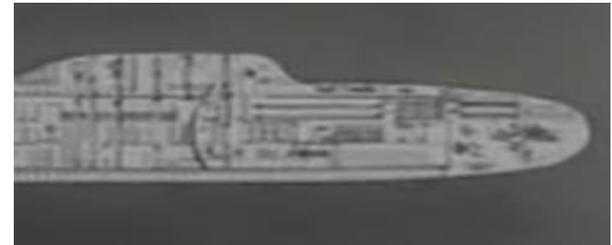
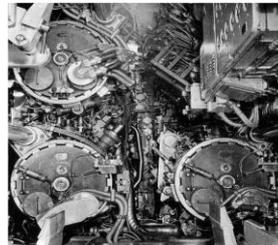
# 1970s – Automation Innovation

## Alfa Class – Automation

- Standardised 6 x 21-inch forward facing fixed torpedo tubes
- Reduced crew so relied heavily on automation
- WSC above sonar array with Torpedo Tubes firing above sonar
- Firing Reload – unknown
- Munitions safety features?



Picture Credit: Covertshores



Picture Credit: NET-film.ru

# 1980s – Flexible Innovation

## Typhoon / Akula SSBN Class – Size matters

- Complex build provides capability at substantive cost.
- Standardised 6 x 21-inch forward facing fixed “Arch” torpedo tubes positioned above the large sonar array
- Carries Squall Rocket Torpedo & STARFISH Anti submarine missiles
- Firing Reload – unknown (Fast automated / two loads per tube)



Picture Credit: Covertshores

# 2010s – Flexible Innovation

## Belgorod SSBN Class – Size matters

- Standardised 6 x 21-inch forward facing torpedo tubes positioned above the large sonar array
- Complex build provides capability at substantive cost
- Carries Squall Rocket Torpedo & STARFISH Anti submarine missiles
- Firing Reload – unknown (Fast automated / two loads per tube)



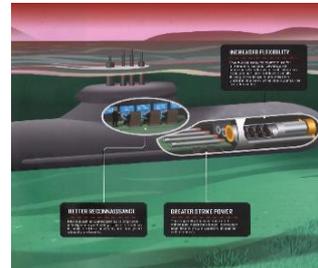
# 2020s – Flexible Innovation

## A-26 AIP Attack Submarine – Flexibility

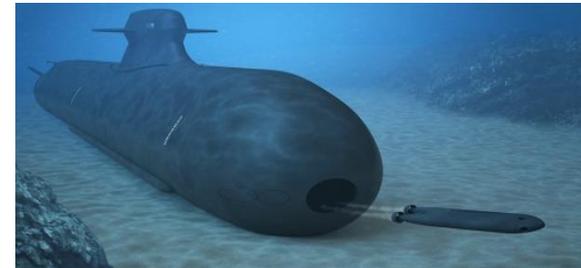
- Capable of a multiple loads incl. LWT / HWT & UUVs
- Firing Reload – unknown (Fast automated)
- Recovery of large expensive UUVs presents a challenge



Picture Credit: Covertshores



Picture Credit:s Saab AB



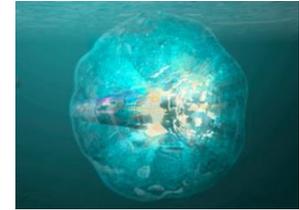


# Evolving Design

Year	Platform Example	WSC Development
1900s	Holland Class	The First WSCs
1910s	K-Class	Dedicated WSCs
1940s	U-Boat	Semi-automated WSCs
1950s	A10 Class	Novel designs
1960s	USS Thresher Class	Acoustic Compromise
1970s	USSR Typhoon	More flexible WSCs
1990s	USS Chicago	Alternative Requirements
2010s	USSR Belogrod	Maximizing Flexibility
2020s	A-26 Class	Multiple Uses
2030s	SMX-31	Full automation

# Technology Drivers

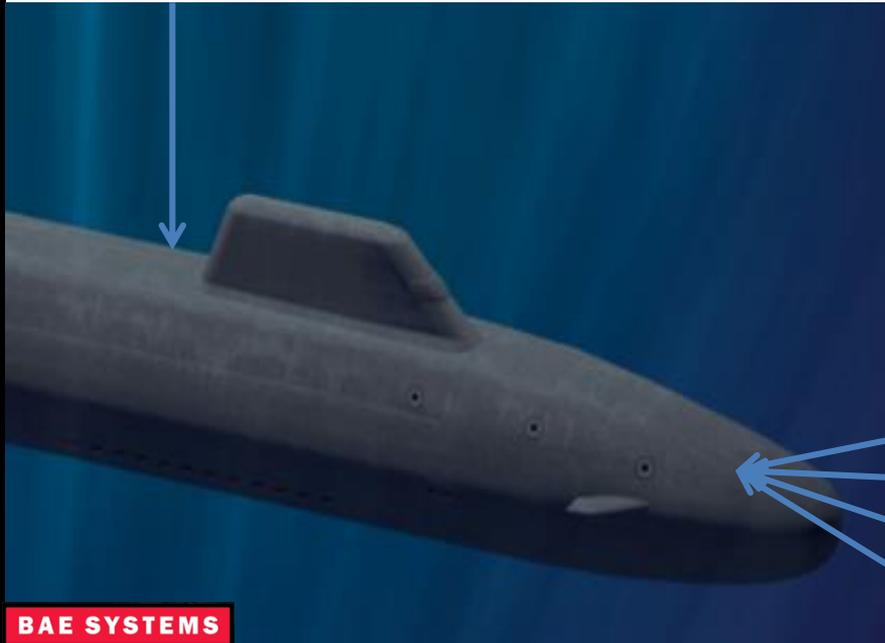
- Energy : Batteries & Propulsion
- Advanced Materials & Manufacturing
- Warhead Development
- Automation
- Modular “Mix & Match”
- EM Rail Launchers
- Common Control Technologies
- Condition Based Monitoring



**Evolution not Revolution**

# WSC Payload Configuration

Land Attack Missiles  
(not covered in this presentation)



Having reviewed WSC development and some of the proposed design options, we have produced a high level concept which addresses:

- Affordability
- Submarine design constraints
- Crew and Munitions Safety
- The following payload options:
  - Tactical Heavy Weight Torpedo
  - Light Weight Torpedo
  - UUVs (medium and small size)
  - Additional Embarked Personnel and Equipment

# Flexible Payload Characteristics

ID	Payload	Length	Dia	Considerations
1	Tactical HW Torpedo	7m	0.5m	Munitions Safety, Shock protection, embarkation & stowage
2	Lightweight Torpedoes	3m	0.3m	
3a	Medium Size UUVs	7m	0.5m	Charging & Data Connections
3b	Small UUVs	3m	0.3m	Lower cost and therefore expendable
4	Bunks and lockers for Additional Personnel	3m	0.5m	Easily embarked, removed, compatible with other payloads, provides additional crew with safety and comfort

# Payload Solutions

ID	Payload	Embarkation
1	Tactical HW Torpedo	Traditional embarkation trolley
2	Lightweight Torpedoes	Half length pallet
3a	Medium Size UUVs	Traditional embarkation trolley
3b	Small UUVs	Half length pallet
4	Bunks and lockers	Half length pallet

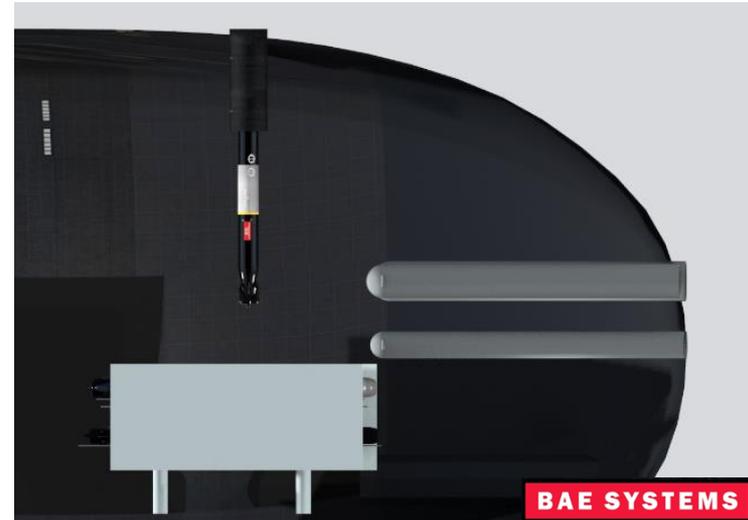
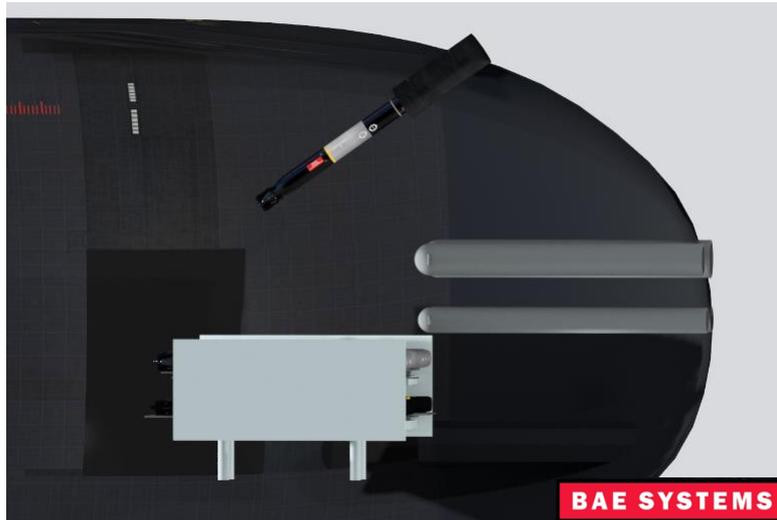
Payload options would ideally be split into 2 categories:

1. Traditional weapon length and diameter
2. Approximately half weapon length and smaller diameter

The upper tier of circa 10 stowage positions could be for full length pay loads  
The lower tier could accommodate either 20 half length payloads or 10 x full length payloads. Other payload variations could be accommodated

# Payload Embarkation Options

UK Submarines use 2 Embarkation Methods, Inclined and Vertical Embarkation. The Future WSC payload trolleys and pallets would be deigned to be compatible with either Embarkation Method.



## Potential Payload Solution – View Looking Fwd.



# Potential Lower Tier Payload - 1

Half length stowage position	Half length stowage position
Half length stowage position	Half length stowage position
Half length stowage position	Half length stowage position
Half length stowage position	Half length stowage position
Full length stowage position	
Centre Line Lift	
Full length stowage position	
Half length stowage position	Half length stowage position
Half length stowage position	Half length stowage position
Half length stowage position	Half length stowage position
Half length stowage position	Half length stowage position

Short small diameter WLT



Short small diameter WLT

10 x full length stowage positions on the upper tier.

Up to 20 stowage positions (LWT, UUV or Bunks) on the lower tier.

# Potential Lower Tier Payload - 2

Half length stowage position	Half length stowage position
Half length stowage position	Half length stowage position
Half length stowage position	Half length stowage position
Full length stowage	
Full length stowage	
Centre Line Lift	
Half length stowage position	Half length stowage position
Half length stowage position	Half length stowage position
Full length stowage position	
Full length stowage position	
Full length stowage position	

Short small diameter WLT



Short small diameter WLT

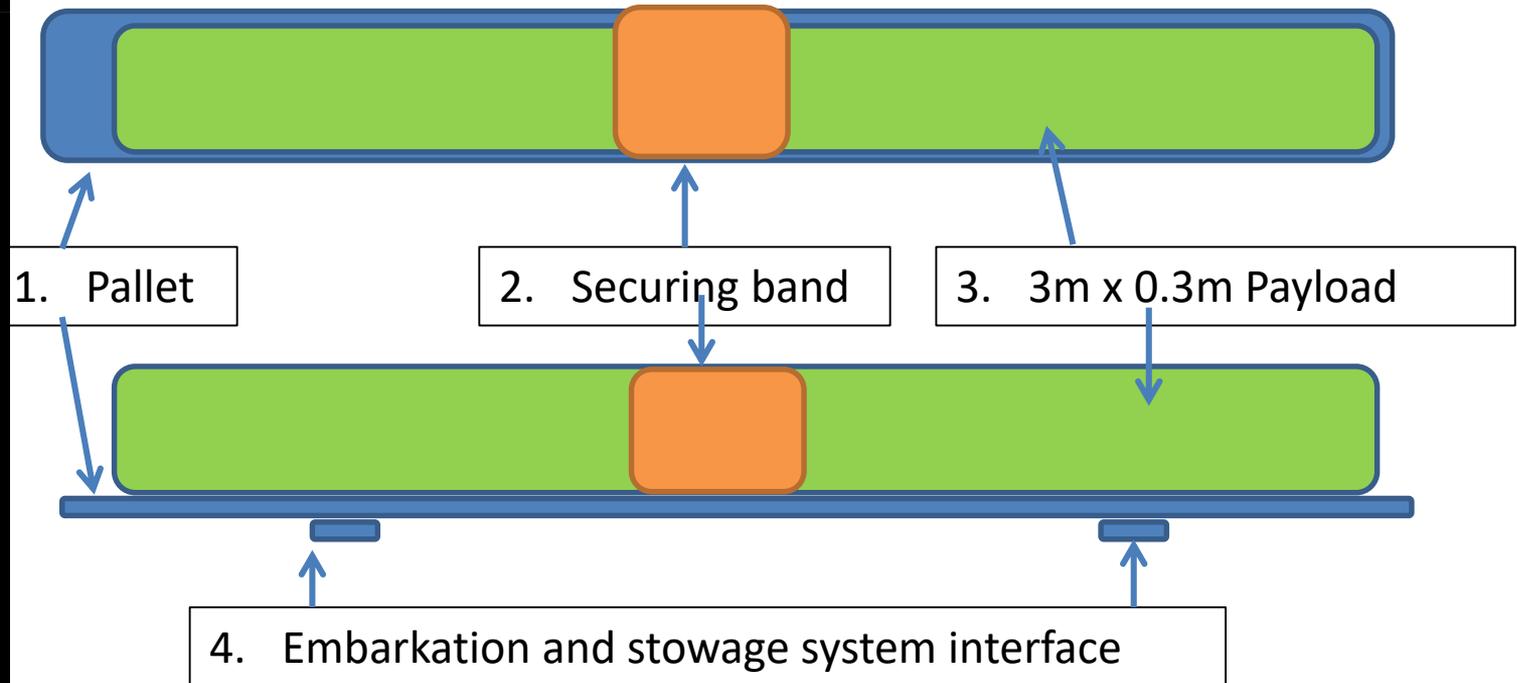
Each stowage position can either be split into two half stowage's or joined to make 1 full length stowage.

## Potential Payload Solution – View Looking Aft.

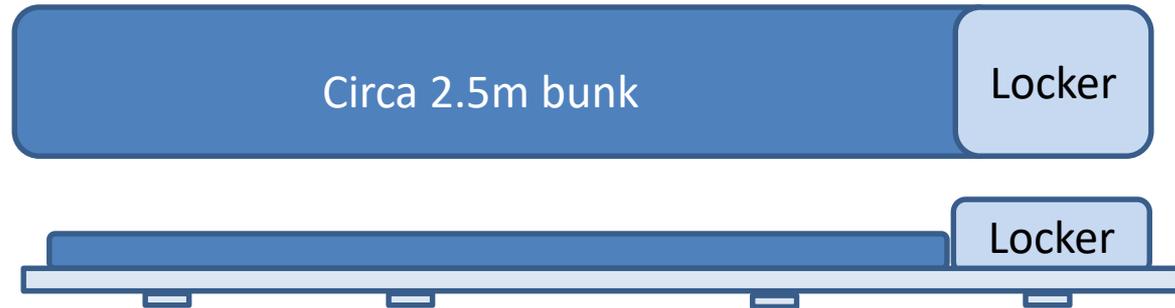


Artistic view

# Half length payload pallet



# Bunk Solution



The bunk and personal locker is embarked and stowed as a pallet which includes connections that link to the weapon embarkation and handling system, enabling ease of handling. The pallet could be adapted to provide only locker space which could be used for trials equipment etc.

# The Future “Bomb Shop”

## Conclusion:

- The design of the WSC has evolved and it will be needed in the future
- Tomorrow’s WSC will retain:

- Munition Safety
- Crew safety
- Fight capability

It could also improve:

- Affordability
- Flexibility
- Modularity
- Automation



# Thank you

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