T26 Global Combat Ship – More Than Just A Submarine Hunter

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Synopsis

The Type 26 Frigate is designed as an anti-submarine warfare platform building on the innovations of the Type 23, with a focus on hull form, machinery mounting, propeller profile, and noise-quieting electric motors. The inclusion of the Mission Bay provides rapid reconfiguration for a range of different operations, enabling the ship to host various capabilities such as autonomous underwater or aerial vehicle launchers, disaster relief stores, detainee handling facilities, military task equipment, and additional boats. The ship's flexibility and modularity enable it to respond to unidentified and evolving threats, making it a truly multi-role combat vessel. However, the adoption of modularized capability insertion comes with limitations, including compromises in growth margin and challenges in doctrine and capability development, logistics, and cost. It brings challenges related to the maturity of capabilities that could be facilitated, requiring extensive procurement and programme management. Overall, the T26 MB is a tangible representation of the Royal Navy's response to the changing global dynamic and its commitment to maintaining a versatile, adaptable, and lethal maritime force.

Keywords: Mission Bay; Capability; Modularity; Flexibility; Lethality

1. Aim

The purpose of this paper is to give the operating context of the Type 26 (T26), to outline the design intent for T26 and its Mission Bay (MB), to explain how the modularity enables greater versatility and lethality, and concludes by discussing the opportunities modularity gives for the future.

2. Strategic Context: From Type 23 to Type 26

The modern battlespace is now a complex, multi-threat environment in a mutli-polar world (Ellwood, et al., 2022, p. 6). The historical context of the Royal Navy’s (RN) Anti-Submarine Warfare (ASW) frigates defending the Iceland-Faroes Gap and nothing else is an obsolete paradigm. This was becoming apparent as the replacement for the Type 23 (T23) Frigate was being designed. The replacement would need to respond to the challenges of undertaking duties beyond that of pure ASW. In 1998 the Future Surface Combatant (FSC) programme was initiated to replace the T23s which were approaching the end of their build programme. The RN needed a ship that was “*An interoperable, survivable, available and adaptable capability that is operable globally within the Maritime Battle Space to contribute to Sea Control for the Joint Force, to contribute to Maritime Force Projection and Joint Force Command and Control with the flexibility to operate across and within the range and scale of Contingent and Non-Contingent Operations.*” (Lonsdale & Lloyd, 2016, p. 34)

By March 2010 the FSC concept had evolved into the Global Combat Ship (GCS). The key change from FSC to GCS was the inclusion of the MB, a versatile integrated facility midships that allows a T26 to organically embark modularised capabilities equivalent to 10 ISO Containers[3] (Jones, 2017). Despite being designed for flexibility, the Type 26 design is still primarily an ASW platform either escorting aircraft carriers or supporting the Continuous At Sea Deterrent as the duty Towed Array Patrol Ship. It shares and develops on many of the innovations that made the T23 Frigate the “*world’s quietest warship*” (Abrahamsen, 2019). This includes hull form, resilient or raft mounting of machinery, propeller profile, the ability to fully de-clutch the gearbox running on GE’s “*Patented noise-quieting electric motors*” (GE Vernova, 2019) and many other features.

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[3] An intermodal container, often called ISO containers because they comply with ISO standards, is a large, standardised container designed built for intermodal freight transport. (Lewandowski, 2016)

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However, the need to incorporate the technology necessary to retain the RN's status as a world leader in operating quiet ships was at odds with the need to provide versatility and modularity required of the GCS concept.

This resulted in a ship design that differs from most platforms capable of embarking ISO containers, with the inclusion of a fully enclosed MB rather than a cargo deck. The fundamental part of this flexibility is the rapid reconfiguration enabled by the MB to prepare the Ship for a range of different operations. The MB enables the ship to host a range of capabilities including autonomous underwater or aerial vehicle, disaster relief stores, detainee handling facilities, military task equipment, additional boats, etc, to deliver the full range of tasks expected of a truly multi-role combatant.

As a concept, MBs are not new, with many navies already operating something similar (Bello & Segovia, 2020) (Doerry & Koenig, 2017). What makes the T26 MB unique is the level of versatility it provides. Unlike other MB designs its ability to launch and recover vessels, reconfigure its contents whilst the ship is underway, and transit additional helicopters or rotary UAVs into the hangar, brings a new dimension to this capability. This means the T26's MB enables additional war fighting capacity not previously available to frigates rather than just being a containerised cargo facility.

3. T26 Design Intent

At 149.9m in length, 20m abeam and displaying a forecast 6,900 tonnes the T26 is significantly larger and heavier than the T23 class. Despite this size increase, automation will allow the ships to operate with a smaller ship's company of only 157 rather than the T23s crew of circa 185. Additionally, the T26 will have a surge capacity of a further 50 austere bunks for embarked forces, trainees, etc... The T26 will be fitted with many of the same primary sensors and weapons as the T23 post mid-life update, including the Artisan 3D air surveillance radar, the S2087 towed array sonar, S2150 bow sonar and the Sea Ceptor variant of the Combined Anti-Missile Missile System (Jones, 2017). In an enhancement to current capabilities the 4.5" medium range gun will be upgraded to 5" and the ship will also be fitted with a silo for the Mark 41 Vertical Launch System capable of embarking a range of weapons including the American Tomahawk cruise missile and the Anglo-French Future Anti-Surface Guided Weapon System. It is propelled by a Combined Diesel Electric Or Gas Turbine (CODLOG) propulsion system comprising of 2 of GE's "*Patented noise-quieting electric motors*" (GE Vernova, 2019) and a Rolls Royce MT-30 Gas Turbine direct drive system for sprint speeds.

The first T26, HMS GLASGOW, is due to enter service with the RN in late 2026 with the final ship, HMS LONDON, due to be decommissioned in the late 2060s forming the backbone of the UK's ASW capability for the next 40+ years. The class will have the capacity to support a wide range of capability enhancements and task specific equipments over its lifespan. This includes having the flexibility to respond to yet unidentified threats which may be commonplace by the latter half of the 21st century. This is enabled through the modularisation offered by the MB which will "*deliver the opportunity to decouple the acquisition pathways of the platform and the capabilities it delivers through its operational life.*" (Parkin, 2022) During its operational life it is expected the T26 will be faced by a range of threats from conventional peer-on-peer warfare in the air, surface and subsurface domains, terrorism, piracy, smuggling, and asymmetric attacks sponsored by hostile states. To respond to these current and emerging threats, the T26 must be able to protect itself, and any high value units it may be required to escort, against an increasingly sophisticated range of conventional and advanced complex weaponry. It will be able to carry out the tasks currently expected of a T23 frigate to a higher standard with the capabilities enabled by the MB, whether deploying as a single unit or acting as an escort.

The MB will facilitate increased lethality through enabling the rapid integration of innovative technologies. "*Technology is moving faster than at any point in history - warfare has the potential to be impacted and the RN needs to be a leading force on the latest technological advances."* (Navy X, 2024) The RN faces a step-change in the operating context of the littoral and maritime domain; the bipolar world of the cold war has come to an end and a multipolar world has emerged with asymmetric threats from state and non-state actors now rife. It is widely thought that "*high technology capabilities*" (Salisbury, 2023) will be a pivotal element in the RN's response to this changing global dynamic. The rate of change is forecast to be far beyond anything experienced since WWII and the RN will need adaptable ships to respond to the evolving threat. One option could be to design a POD with the 150kW-class Laser DEW weapon to de-risk the planned retrofit to as part of Project MIMAS; a vision to inform the RN's projected Future Air Dominance System (FADS) but sufficient power availability in the mission bay could be a limiting factor that would need to be explored. (Scott, 2023)

Occupying an area of some 300m^2 midships in the heart of 1 deck, the T26 MB is one of the RN's responses to this call. At 20m wide, it occupies the entire breadth of the ship's layout and is connected to the hangar immediately aft. (Jones, 2017) It has access to sea on both sides through two hydraulically powered doors and is fitted with an integrated Mission Bay Handling System (MBHS). This is an integrated overhead crane capable of embarking and moving ISO containers within the MB in 3 planes of motion and able to move/rotate with 6 degrees of freedom; enabling it to launch and recover boats and uncrewed vehicles. The MB will be able to house new and novel weapons systems in self-contained ISO containers. This means that when new threats are identified, such as that from Uncrewed Air Vehicles (UAVs), bespoke weapons systems can be developed ashore and embarked rapidly into the Ship. This will significantly reduce the time taken to embody new capabilities from months or even years, to days or even hours. Examples of potential containerised capabilities are shown below in figure 1:

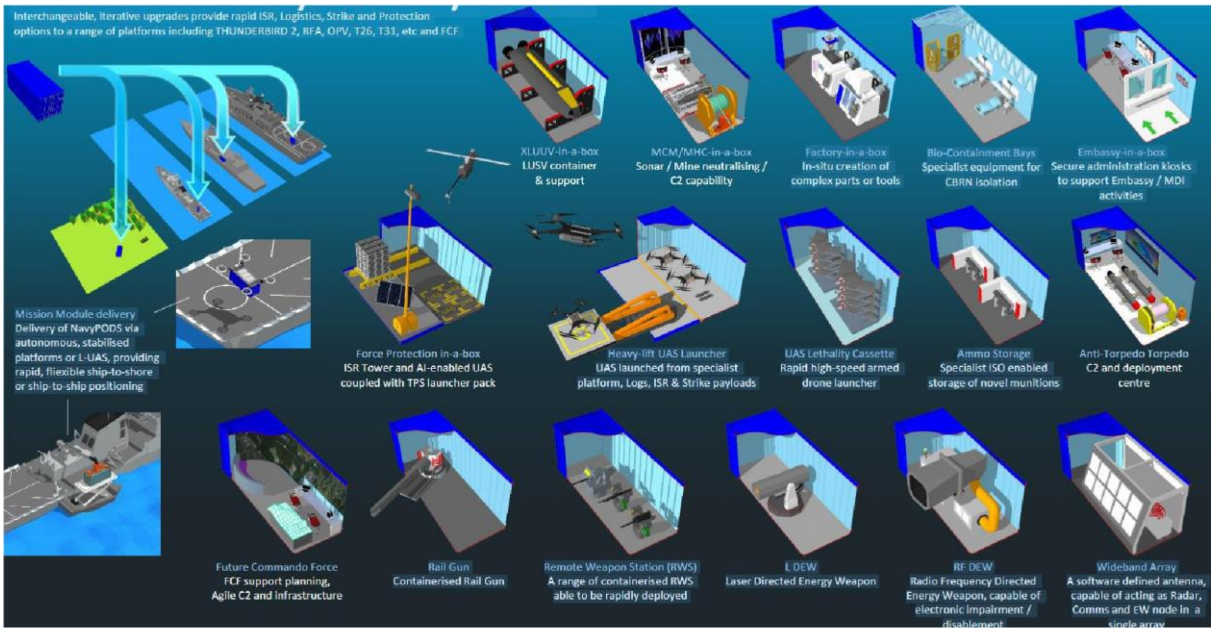

Figure 1: MB Module Concepts (Parkin, 2022, p. 32) © Crown Copyright 2022

4. Benefits Of The T26 Mission Bay

The immediately apparent advantage of the MB is the ability to rapidly embark new capabilities to best tailor the ship to each mission. A range of capabilities have begun to be containerised and the RN can also rely on existing containerised facilities. This includes Humanitarian Aid and Disaster Relief Stores, Role 3 medical facilities in a box, small ships support capability, additional containerised austere accommodation, additional containerised auxiliaries such as Chilled Water Plants or cold rooms and even a holding facility for captured personnel/detainees. This already gives flexibility in tailoring a ship to meet the specific requirements of the operation or tasking it is undertaking, as well as the ability to embark additional resilience against Operational Defects.

As well as the dynamic nature of capabilities fitted within a T26, the MB will be an integral part of the RN's future autonomous vehicle capability. Whilst most RN platforms will be able to deploy UAVs, there are a limited number of platforms that will be able to operate Uncrewed Surface Vehicles or Underwater Under-water Vehicles (UUVs), particularly in high threat areas. The complexity of integrating a remote operated vessel into a warship's order of battle cannot be overstated. It is a problem with which navies around the world are grappling. The T26 MB will be a paradigm shift in their integration. Not only can it launch and recover them organically it can change between uncrewed mission systems in a matter of hours, disembarking UAVs and embarking USVs or UUVs in the same day. The RN's most recent Maritime Operating Concept stressed the importance of uncrewed platforms working in tandem with conventionally crewed and remotely crewed systems: "*Greater uncrewing, combined with a distributed force, will continue to demand highly trained and technically skilled people to provide the necessary support which underpins availability and force support*." (Parkin, 2022)

The modular MB design does not come at zero cost. With the requirement to retain more than 150 tonnes of topweight to enable up to 10 ISO containers of up to 15 tonnes each, compromises have had to be made. The main compromise is the reduction in growth margin and as a result there is very limited stability margin left to consume through life, despite the weight of the Ship. Whilst the MB enables the rapid insertion of discrete, modularised capabilities, that has come at the cost of the ability to fit additional capability as part of the Ship's permanent outfit, particularly if those new capabilities are heavy or high up within the ship.

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Secondly, and arguably more importantly the adoption of modularised capability insertion is only viable if there are modules to embark. This requires a paradigm shift in doctrine at the concept phase of the CADMID/T life cycle. Future operational and capability requirements must be geared towards making best use of the MB capability. This requires not only that the mission modules be developed but that all the Defence Lines Of Development are considered for this capability to be revolutionary and to deliver its full potential. The support and storage facilities, the off-ship maintenance, the training, etc… all need to be considered if the MB is to be a success. All this clearly has associated cost on top of the reported £1.31 Billion per platform. Many of the more innovative options are only at the Concept/Assessment phases of the CADMID/T[4] cycle. Looking at existing missions that T26 could be tasked to undertake based on the existing operating profile for T23s, the capability enhancement offered by the MB has been assessed for maturity using a RYAG scale. Green represents capabilities already in service, Yellow represents COTS capabilities that are tested and ready to begin integration trials on RN platforms, Amber represents capabilities which are in the Design phase of the CADMID/T Cycle and Red represents capabilities in the Concept phase of the CADMID/T Cycle. It is important to stress that this assessment is of the maturity of the capabilities that could be housed in the MB to enhance operational effectiveness. It is not an assessment of how effective the T26 will be at completing the tasks/operations.

Counter Narcotics or Anti-Piracy piracy operations, such as those undertaken in the Caribbean and Horn of Africa, are assessed as green with only UAVs and Captured Persons Handling Facilities not yet fully established as in service capabilities. The Future Tactical Uncrewed Air System project has concluded that the Schiebel S100 Camcopter is the preferred system to enter service as PEREGRINE. It is due to enter service on HMS LANCASTER in late 2024 (Claridge, et al., 2023). Likewise Humanitarian Aid and Disaster Relief operations and Littoral Strike operations in the form of SF insertion or Amphibious Raiding are also assessed as green with FTUAS/Peregrine being an optional capability.

Deterrence and Mercantile Marine Escort Duties in the Arabian Gulf/Gulf of Oman region in support of Op Kipion are assessed as yellow driven by the immaturity of the DragonFire counter UAV capability. In April 2024 it was announced that DragonFire will enter service in 2027 on an RN vessel (Shapps, 2024), however a containerised solution has not yet been procured. With the full ORBAT of the RN's autonomous underwater capability is yet to be defined, the assessment of the enhancement to the Towed Array Patrol Ship Duty is also yellow. Whilst the RN has already procured 3 x Remus 100 UUVs, this capability is assessed as amber as it has only been trialled for use in a mine warfare context (DSTL, 2024). The RN has also contracted for a Very Large Uncrewed Underwater Vehicle (VLUUV) called Cetus which is currently at the assessment phase of the

[4] The CADMID/T cycle is the project lifecycle model used by all branches of the Ministry of Defence (MOD): The Concept, Assessment, Demonstration, Manufacture, In-Service and Disposal/Transfer (CADMID/T) cycle. (Parkin, 2022)

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CADMID/T Cycle and as such is assessed as Red. The MB maturity assessment for each of the operations currently undertaken by T23s is graphically presented below in figure 2:

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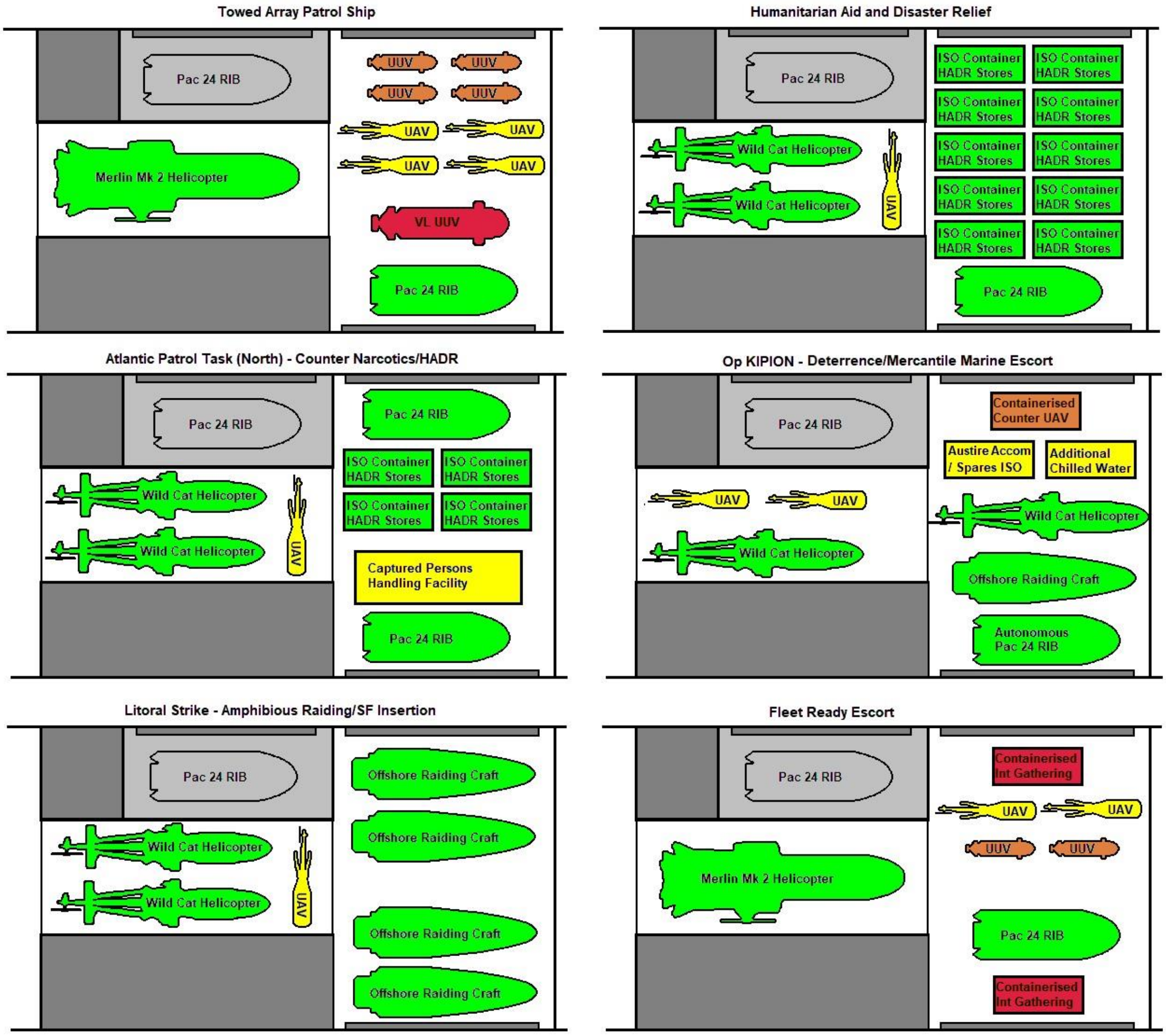

Figure 2: Graphical representation of maturity levels of capabilities likely to be carried in the MB by operational tasking.

There is, therefore, extensive procurement required - CETUS VL UUV, DragonFire Counter UAV, Remus UUV and Peregrine UAV - for the full lethality of the MB to be realised. Each of these capabilities has a programme in place and it is likely that they will deliver this as a stand-alone system before T26 reaches its Initial Operating Capability (IOC) currently forecast for 2028. (Webb, 2024)

5. MB Handling System Operation

Whilst at its core the MB concept itself is simple: Store Containerised Capabilities onboard (Parkin, 2022) the capability of the MB can only be fully realised with an organic means to embark, disembark, and re-configure modules, which is the capability provided by the MB Handling System (MBHS). The means to move modules in, out and around the MB, turns an empty space into a force multiplying asset.

The MBHS primary purpose is to launch and recover boats, USVs and UUVs from either side of the ship whist underway in sea conditions up to sea state 4. It must also be able to safely lift items varying in shape, dimension and weight from any of the nominated tie down locations up to the boundaries of the MB. The MBHS must also be able to embark containers and other capabilities from the dock side to avoid the requirement to rely on dock-side facilities. As well as launch and recovery of and vessels or autonomous vehicles, the MBHS must be able to transfer the craft between its storage and launch positions and, if necessary, move it to a different location within the MB. The MBHS must be able to lift items up-to 15 tonnes in weight including crewed systems or capabilities up-to 10 tonnes in weight. It will be compatible with NATO standard ISO containers as well as equipment that may not be compatible with ISO twist-lock connectors. However, whilst containerising capabilities is the preferred solution it is understood that this may not always be possible. Rolls-Royce Canada, in Ontario

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was chosen as the preferred supplier in 2014 because of their extensive record and expertise developing and building load lifting equipment for the commercial marine sector. The full contract for production of the MBHS for all three ships in Batch 1 was placed in 2018. In total across 3 nations there are expected to be at least 29 ships operating the MBHS; in addition to the 15 Canadian vessels, there will be 8 RN ships and 6 Australian vessels. (Jones, 2017)

The flexibility and adaptability of the platform through the MB comes with it’s challenges. The MBHS is a complex mechanical and electrical system of systems which includes the hydraulically operated MB doors and the emergency generator back-up to enable launch of a PAC 24 sea boat in the event of a total loss of electrical supplies. This is due to the MBHS secondary duty as the launch and recovery method for the starboard sea boat. While the maintenance and defect repair of the individual components and systems is captured as part of the RN’s core career training, the safe operation of the system is unique to T26 and a challenging and expensive requirement. Notwithstanding this, a factory environment does not replicate the lived experience of an operating ship, such as pitch and roll conditions and the challenges of embarking and disembarking containers through the MB doors which are not an integrated part of the test facility. Therefore, generation of Standard Operating Procedures and team training may result in utilisation of the onboard system in the First of Class platform. While this appears a sensible and practical solution, operating a complex system such as the MBHS during build will inevitably result in conflictions and possible delays in the build programme.

The MBHS itself is mounted across the width of the MB compartment deckhead on twin I-Beam rails. The complete carriage assembly is then suspended from the rails via 8 roller truck assemblies. This allows the carriage assembly to be moved across all aspects of the MB, allowing for different configurations as required. The height of the compartment and dimensions of the carriage assembly do not allow for loads to be moved over other loads. The assembly is split into upper and lower carriage systems. The upper carriage facilitates slewing activities via a slew ring and chain drives and the lower carriage facilitates the booming activities via boom and luffing cylinders. (Morrow, 2018)

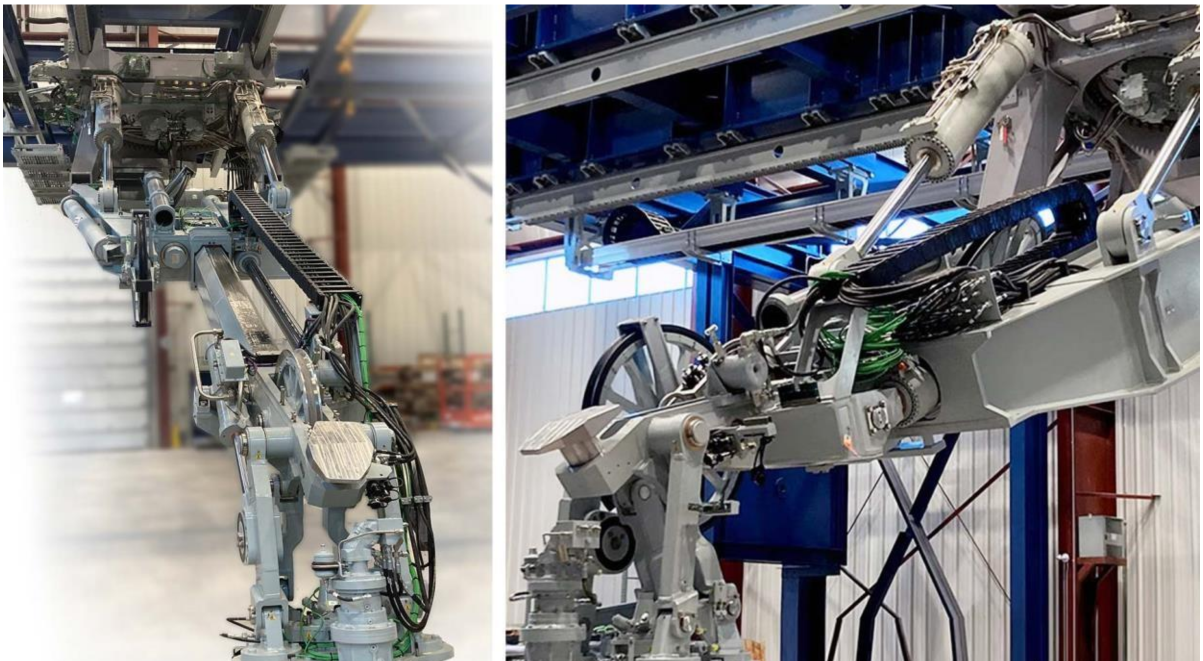

Figure 3a: The first MBHS assembly to be manufactured by Rolls Royce. Extended (left) and retracted (right). (Morrow, 2018) © Rolls-Royce plc 2024

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Figure 3b: Mission Bay Handling System Boat Assembly (Morrow, 2018) © Rolls-Royce plc 2024

6. Stability and Loading

As with all vessels, maintaining good stability is paramount in ensuring both hull and crew safety and largely attributed to weight and weight movement. The stability considerations are greatly increased in T26 when considering the embarkation and disembarkation of containers totalling 150 tonnes.

"*A further risk to be considered in the ship building area is the platform structural integrity and balance effects of large MBs.*" (Parkin, 2022, p. 19)

Early on, redundancy in "margins" is considered to allow for growth and future upgrade. Margins are defined as contingency allowances on systems and structure used to manage the impact of uncertainties and to accommodate for through life change. Failure to provide sufficient margin could lead to platforms being unable to accommodate future change, upgrade or refit and ultimately unable to go to sea. Margins are instantiated through physical characteristics like size, weight, and system capacity, margins cost money, and compete for these parameters with the baseline warfighting capability of the ship at delivery (Catton, 2022). It is important that margins are controlled effectively to support the capability requirements through to Out of Service Date (OSD).

At the Initial Preliminary Design Review, it was reported that the Design and Build Margin associated with weight had been completely utilised due to a revised steel weight estimate, together with other equipment weight increases. A weight optimisation activity was initiated with the aim of recovering sufficient Design and Build Margin to take the vessel design and build to OSD. Through a combination of weight reduction initiatives, such as pipework optimisation and Urea concentration increase, together with a re-assessment of critical design limits, revised Design and Build margins were established (Table 1).

Description	**Margin**
Hull and Superstructure	6.2%
Armour	6.2%
Propulsion	7.13%
Electrical	8.35
Control and Communications	7.7%
Auxiliary Systems	8.6%
Outfit and Furnishings	9.6%
Armament	6.4%
Operating Fluids	10%

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Effective Wholeship DBM	455tonne

Table 1: Revised T26 Design and Build Margins

Many considerations are made during the design phase for potential growth and upgrades that will affect margins, known as Installation Provision Made In-design (IPMd). This will account for all margins (including weight), which will allow for a faster, more efficient fit that will not require in-depth analysis as they have already been factored. The MB containers are included in the IPMd and has accounted for a total capacity of 150 tonnes of containers or equipment. The maximum allowable weight of a single FEU is 15 tonnes (Morrow, 2018)

The In-Service Growth Margin (IGM) is defined as an allowance for unattributable growth to the platform throughout its in-service life and is applicable to the weight and Vertical Centre of Gravity (VCG) of the platform. The IGM is managed by modelling the weight and VCG using growth rates and known design changes. The modelling will be verified for each build model by conducting incline tests in accordance with the Maritime Acquisition Publication on "Stability of Surface Ships". Changes in VCG can occur for two main reasons; an addition of weight high up in the ship or a reduction in weight low down which results in an increase in the VCG. The second is inaccurate assessments of initial VCG or changes in the vertical location of moveable weight items giving a decrease in VCG. Given the relatively low effective wholeship DBM of 455tonnes, the margin will need to be managed carefully by the platform Chief Engineer through life, prioritising upgrades as necessary and ensuring the acceptable limits of VCG are not compromised as a result. This could result in the capacity of the MB being reduced to 8 or even fewer ISO containers.

Consideration could be made towards utilising the allocated container loading provision (150 tonnes) through the IPMD as potential growth margin for platform capability. The MB containers can be embarked, disembarked and repositioned relatively easily using a stability model to calculate the effect. The onboard ballast system that is designed with the MB as an area of significant stability implication, can then be used to ensure the platform remains within allowable limits. The decision to utilise the MB margin as Wholeship DBM would come with greater affect. Any change proposal would need to follow the lengthy full acceptance routine which would include a feasibility study, Installation Solution (IS) and generation of an Engineering Guidance Pack. It would also necessitate significant re-evaluation of the stability profile to account for the potential removal of the 150 tonnes of top weight accommodated by the MB contents and addition of weight at other points across the ship. This could include docking for inclining experiments, at relatively significant cost to the MOD but more importantly take platform availability away.

7. Conclusion

The inclusion of the MB provides rapid reconfiguration for a range of different operations, enabling the ship to host various capabilities such as autonomous underwater or aerial vehicle launchers, disaster relief stores, detainee handling facilities, military task equipment, and additional boats. The ship's flexibility and modularity enable it to respond to unidentified and evolving threats, making it a truly multi-role combat vessel. However, the adoption of modularized capability insertion comes with limitations, including compromises in growth margin and challenges in doctrine and capability development, logistics, and cost. It brings challenges related to the maturity of capabilities that could be housed in it, requiring extensive procurement and programme management. Overall, the T26 MB is a tangible representation of the RN's response to the changing global dynamic and its commitment to maintaining a versatile, adaptable, and lethal maritime force.

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Glossary of terms

T26	Type 26
MB	Mission Bay
RN	Royal Navy
ASW	Anti-Submarine Warfare
T23	Type 23
FSC	Future Surface Combatant
GCS	Global Combat Ship
ISO	International Standardisation Organisation
GE	General Electric
PCE	Platform Chief Engineer
DPCE	Deputy Platform Chief Engineer
UAV	Unmanned Aerial Vehicle
CODLOG	Combined Diesel Electric or Gas Turbine
PODS	Persistent Operational Deployment Systems
FADS	Future Air Dominance System

LDEW	Laser Directed Energy Weapon
MBHS	Mission Bay Handling System
CADMID/T	Concept Assessment Development Manufacture In-Service Disposal / Transfer
COTS	Commercial Of The Shelf
RYAG	Red Yellow Amber Green
ORBAT	Order of Battle
DSTL	Defence Science and Technology Laboratory
IOC	Initial Operating Capability
NATO	North Atlantic Treaty Organisation
PAC 24	Pacific 24
OSD	Out of Service Date
DBM	Design Build Margin
IPMD	Installation Provision Made in Design
FEU	Forty foot Equivalent Unit
IGM	In-service Growth Margin
VCG	Vertical Centre of Gravity

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