Carrier comeback: Investing in power projection

Established and emerging maritime powers are continuing to invest in big-deck aircraft carriers. Richard Scott reports

The aircraft carrier became established as the pre-eminent naval power-projection asset during the Second World War, yet for much of the period since 1945 there has been fierce debate over the military value and cost-effectiveness of organic fixed-wing naval air power.

Critics have argued long and hard that the high cost associated with carrier construction, workup, operation, and support does not translate in terms of cost or mission effectiveness and that an aircraft carrier consumes disproportionate force structure through its requirement for accompanying escorts and afloat support. Furthermore, the primacy and cost of the carrier may adversely affect investment in other capabilities.

Cost is not the only stick used to beat the carrier. Some commentators argue that the carrier and its air group are increasingly put at risk by advanced and proliferating anti-access/area denial (A2/AD) threats. They further contend that land-based strike aircraft and long-range cruise missiles represent a viable alternative to the naval air wing, characterising the aircraft carrier as an arcane and potentially vulnerable leviathan in a new age of asymmetric adversaries and cyber warfare.

However, proponents have remained equally convinced that the carrier and its embarked air group continue to offer a uniquely mobile, flexible, reconfigurable, and truly independent platform for sustained operations at reach. These advocates further claim that the carrier, through its ability to enable the projection of tactical air power independent of access, basing, and overflight rights endures as a ‘platform of necessity’ in an era of expeditionary operations where host-nation support may be unavailable or comes with significant political and/or military constraints and risks attached.

Supporters also contend that the aircraft carrier must be recognised as a political instrument by which to demonstrate diplomatic posture and military resolve. In that sense it can be seen as an embodiment of national prestige – indeed, a mechanism by which to exert political influence on the world stage – as much as a pure instrument of naval power.

What is undeniable is that the business of generating and sustaining fixed-wing air power from the sea is costly and complex. Much more than just a floating airfield, the aircraft carrier and its embarked air wing only realise their potential from an intricate choreography – blending equipment, manpower, training and rehearsal, organisation, procedure, infrastructure, and doctrine – that must function coherently to deliver a safe and effective capability.

The air group is the weapon system of the carrier, so the primary metric by which to quantify its output is the sortie generation rate (SGR). This is conditioned by a whole host of interacting factors, including the following: the size of the air group; the number of aircrew; aircraft maintenance intervals; fuelling and preparation on deck; the number of aircraft maintainers or number of aircraft that can be maintained simultaneously; sortie duration; the preparation, delivery,
and loading of ordnance on the flight deck; the movement of aircraft between the hangar and flight deck; the positioning and re-positioning of aircraft on the flight deck; launch and recovery cycles; air traffic control; aircrew rest periods and limits on aircrew cumulative flying hours; the number of days that sorties need to be flown; mission pre-briefing and post-briefing time; and underway replenishment at sea.

Operations must in turn be supported by a comprehensive strike planning and air-management infrastructure. This places significant demands on connectivity and bandwidth and the provision of organic facilities to enable the timely exploitation of intelligence, surveillance, and reconnaissance feeds.

Furthermore, the carrier and its air wing do not operate in isolation, but deploy as the centrepiece of a carrier group that will typically also feature anti-air and anti-submarine escorts, as well as afloat support shipping. That group will also require support from a submarine and long-range maritime patrol aircraft.

Therefore, the big-deck carrier club brings high costs of admission and membership that few navies can afford. Over the past half century Argentina, Australia, Canada, and the Netherlands have all elected to divest, or have found themselves unable to sustain, a carrier capability owing to resource shortfalls and/or material obsolescence.

Brazil has found itself the latest nation to exit fixed-wing carrier operations, with the Marinha do Brasil announcing in February that it had abandoned plans for the modernisation and service life extension of the carrier Sao Paulo (ex- Foch ). This decision reflected the age and material condition of Sao Paulo and the costs, technical risks, and extended timeframe that would have been associated with the modernisation of a ship that is already more than 55 years old.

The introduction of navalised short take-off and vertical landing (STOVL) aircraft from the 1970s onwards offered a means by which to take air power to sea – albeit with limitations – without the full costs associated with conventional catapult launch but arrested recovery (CATOBAR) methods. India, Italy, the Soviet Union, Spain, and the United Kingdom all went on to acquire STOVL carriers and air groups.

Thailand was also briefly a member of the club, having acquired a handful of AV-8S Harrier fighters from Spain in the late 1990s attendant to the procurement of the small carrier Chakri Naruebet . However, these were retired in 2006, leaving Chakri Naruebet operating helicopters only.

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United States

The nuclear-powered aircraft carrier (CVN) and its embarked air wing have, for many decades, been regarded as the most visible expression of forward-deployed US power projection. Indeed, the primacy of the carrier and its supporting strike group has been front and centre of US Navy (USN) strategic thought and surface-force structure since the end of the Second World War.

Today the USN alone is able to deliver carrier air power at a large scale. Its fleet of 11 nuclear-powered ‘super-carriers’ and their embarked air wings offer a full range of capabilities – including long-range airborne early warning and control, air defence, deep strike, reconnaissance, electronic attack, anti-surface warfare, and anti-submarine warfare – at a weight and tempo beyond the
reach of any other naval force. Today’s USN air wing typically numbers about 60 aircraft, comprising a mix of F/A-18E/F Super Hornet strike fighters, EA-18G Growler airborne electronic attack aircraft, E-2C or E-2D Hawkeye airborne early warning and control aircraft, and MH-60R/S helicopters.

An F/A-18F Super Hornet assigned to Strike Fighter Squadron 213 lands aboard the Nimitz-class aircraft carrier USS George H W Bush (CVN 77) during Exercise ‘Saxon Warrior 2017’. (US Navy)

The F-35C Lightning II fighter is expected to achieve IOC in 2018; Strike Fighter Squadron 101, the F-35C training squadron, began carrier qualification training on board USS Abraham Lincoln (CVN 72) in September.

The USN plans to acquire an unmanned aerial refuelling system in the shape of the MQ-25 Stingray, which will enter service early in the next decade. The MQ-25 will provide the carrier air wing with a persistent, sea-based aerial tanker to free up Super Hornets from ‘buddy tanking’ missions and significantly extend the reach of carrier-borne strike fighters.

The new CVN-78 Ford-class nuclear-powered carrier has been developed as the successor to the CVN-68 Nimitz-class design, 10 of which have been delivered to the USN since the late 1960s, with each carrier designed for a service life of 50 years.

Huntington Ingalls Industries’ Newport News Shipbuilding division delivered Pre-Commissioning Unit Gerald R Ford (CVN 78) to the USN on 31 May following completion of acceptance trials on 26 May. The vessel, the lead ship in the Ford class, was commissioned into service as USS Gerald R Ford on 22 July.

At approximately 100,000 tons displacement, Gerald R Ford is the largest warship ever built; at a cost of just less than USD13 billion, it is also the most expensive.
USS Gerald R Ford (CVN 78) is the first Ford-class nuclear-powered aircraft carrier and, at just under USD13 billion, the most expensive warship ever built. (US Navy)

While the CVN 78 design shares the same hull form as the Nimitz class, it incorporates a number of significant changes with regard to its aviation facilities. The USN requirement is for an SGR of up to 160 sorties per day (12-hour fly day), surging to 270 sorties per day (24-hour fly day), compared with the Nimitz-class SGR demonstration of 120 sorties per day/240 sorties per 24-hour surge. Design changes to support this increase include a slightly larger flight deck, three aircraft elevators instead of four, dedicated weapon-handling areas, and an increased number of aircraft refuelling stations.

The island superstructure has been both repositioned and redesigned. CVN-78 will be the first and only USN ship to field a dual-band radar suite comprising the X-band AN/SPY-3 multifunction radar and the S-band AN/SPY-4 volume search radar.

Gerald R Ford is also the first CVN designed with all-electric utilities, which eliminates steam service lines from the ship, thereby reducing maintenance requirements and improving corrosion control. The ship's new A1B reactor plant is intended to operate at a reduced manning level (50% less than a CVN 68-class ship) while producing significantly more electrical power.

Another major change is the replacement of the legacy C-13 steam catapults with a new Electromagnetic Aircraft Launch System (EMALS) developed by General Atomics. The old hydraulic arresting gear is also being replaced by an Advanced Arrestor Gear (AAG) system, again developed by General Atomics. Both EMALS and AAG have completed extensive land-based testing after protracted development.
China

Chinese interest in carrier aviation goes back to the 1980s, but it was with the acquisition of the incomplete hulk of the Soviet-era Project 1143.5 carrier Varyag by a Macau-based trading house in 1998 – ostensibly for conversion to a floating casino – that its ambitions began to take a tangible form.

Following tow to China where the ship arrived in early 2002, the hulk of the Varyag was taken for docking, survey, repair, and eventual completion in Dalian. Commissioned as Liaoning in September 2012 after a lengthy fitting out period, the ship began first trials with the J-15 ‘Flying Shark’ aircraft in November that year. Further flight trials were subsequently completed with J-15s to expand the operational envelope and clear a range of stores.

The Chinese carrier Liaoning pictured with eight J-15 carrier-borne fighters on its flight deck. (via fyjs.cn)

Liaoning was initially assessed to be a training carrier rather than an operational asset, conducting short embarkations mainly in the Bohai and Yellow Seas for training support. However, the ship and its air group were declared ready for combat operations in November 2016 and shortly afterwards the carrier and escorts deployed into the western Pacific for the first time.

China’s first indigenously built carrier, referred to as the Type 001A, began construction in late 2013 and was floated out from its building dock at Dalian on 26 April this year. While clearly based on the Liaoning design template, and thus designed for STOBAR fixed-wing operations, the as-yet-unnamed second carrier incorporates a number of design improvements with regard to flight-deck arrangement, aviation spaces, propulsion machinery, and radar systems.

Analysts estimate that outfitting and setting-to-work will take about two years, after which the ship will begin sea trials. Entry into service is expected in the early 2020s.

Meanwhile, Chinese state media have reported that construction of a second indigenous carrier has begun at the Jiangnan Changxingdao shipyard near Shanghai. There is speculation that this ship will incorporate catapults and arrestor gear, making it significantly different from its predecessor. However, it is as-yet unclear whether steam catapult or electromagnetic launch technology will be adopted.

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India

The Indian Navy has completed its transition from STOVL to STOBAR operations with the May 2016 retirement of the last Sea Harrier FRS.51 fighters operated by Indian Naval Air Squadron 300 and the decommissioning of the 57-year old INS Viraat (ex-HMS Hermes) in March. For now that leaves INS Vikramaditya (ex- Admiral Gorshkov), embarking a fixed-wing air group of MiG-29K multirole fighters, as the service’s sole carrier.

INS Vikramaditya (foreground) pictured in company with INS Viraat in early 2014. Viraat was formally decommissioned in March this year. (Indian Navy)

Commissioned into Indian service in late 2013, the 44,500-tonne-displacement Vikramaditya is a rebuilt Project 1143.4 modified Kiev-class carrier/cruiser originally built for the Soviet Navy for operations with the Yak-38 ‘Forger’ STOVL aircraft. A USD1.5 billion contract with the Russian government was originally signed in 2004 for the regeneration and conversion of the long-mothballed ship – adapting it from its original STOVL configuration to a new STOBAR arrangement – together with the acquisition of 12 MiG-29K single-seaters and four MiG-29KUB two-seat trainers.

Vikramaditya was scheduled for delivery in August 2008, but work at the Sevmashpredpriyatie shipyard in Severodvinsk quickly fell behind schedule as the full scale of remedial and reconfiguration work became apparent. As the delays increased the Indian government also found itself hostage to Russian demands for additional payment.

After much wrangling a revised delivery agreement was signed in March 2010 under which the price increased to USD2.33 billion and handover was pushed back to December 2012. An order for an additional 29 MiG-29K aircraft was also agreed.
In the event, the commissioning of Vikramaditya was further delayed after sea acceptance trials in September 2012 revealed problems with a number of the ship’s boilers. Following repairs and further trials the ship was finally commissioned in Severodvinsk in November 2013; the ship arrived in India in January 2014.

Vikramaditya can embark an air wing of about 30 aircraft. These include MiG-29K fighters and Ka-28, Ka-31, Sea King Mk 42, Dhruv, and Chetak helicopters.

India’s aim of sustaining a force of at least two aircraft carriers is driven by the desire to maintain a carrier on both its east and west coasts. Approval for construction of a first indigenous aircraft carrier (IAC) was originally given in May 1999, with subsequent revisions in October 2002 and July 2014.

Known as Project 71, the 40,000-ton IAC design has been developed by the Directorate of Naval Design with support from Fincantieri (propulsion system integration) and the Nevskoye Design Bureau (aviation). The ship, to be named Vikrant, was laid down at Cochin Shipyard Ltd (CSL) in Kerala in February 2009 and was formally launched in August 2013.

However, the delivery schedule for Vikrant remains uncertain. While the navy had projected delivery in December 2018, a July 2016 report from India’s Comptroller and Auditor General revealed that CSL believes that the ship will not be completed until 2023.

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class (QEC) carriers – departed Rosyth, Scotland, to begin contractors' sea trials. The expectation is that the ship will be accepted by the RN before the end of this year.

The Royal Navy’s new aircraft carrier, Queen Elizabeth, pictured with the US Nimitz-class aircraft carrier USS George H W Bush (CVN 77) and its strike group during Exercise ‘Saxon Warrior 2017’ in August. (US Navy)

Sister ship Prince of Wales was formally named at Rosyth on 8 September. The ship will now complete fitting out before commencing sea trials in 2019.

Built by the Aircraft Carrier Alliance – a partnership of BAE Systems, Babcock, Thales, and the Ministry of Defence – the QEC ships are not ‘like-for-like’ replacements for the RN's three Invincible-class carriers (CVSs). Rather, they represent a return to big-deck carrier aviation focused on the delivery of air power from the sea at the medium scale.

Ship size has been primarily dictated by the demanding SGR promulgated at the early stages of what was once the CV(F) programme. This has driven the size of the flight deck (some 4.3 acres compared with 1.6 acres on the CVS) and the hangar space.

Queen Elizabeth will start First of Class Flight Trials (FOCFT) (Rotary Wing) early next year. An eight-week period of FOCFT (Fixed Wing), with two F-35B aircraft embarked, will follow in the fourth quarter off the eastern seaboard of the United States.

As well as ski-jump launches and vertical landings, it is expected that next year’s trials will include the first executions of a new manoeuvre known as a shipborne rolling vertical landing (SRVL). An SRVL exploits the ability of the STOVL F-35B to use vectored thrust to slow the speed of the aircraft approach to about 35 kt of closure relative to the carrier while still gaining the benefit of wingborne lift. The primary benefit of an SRVL is a significant increase in payload ‘bring back’ compared with a 'standard' vertical landing.
During 2019–20 there will be further fixed-wing trials, workup for the embarked battle staff, and the building up of the carrier strike group construct. IOC (Maritime) in the carrier-strike role is planned for late 2020, with FOC to follow in 2023.

The concept of carrier-enabled power projection (CEPP) broadens the scope of employment beyond fast jet carrier strike capabilities to exploit the wider use of the QEC carriers as rapidly reconfigurable joint operating platforms. The CEPP concept of employment (CONEMP) single statement of user need describes “an integrated and sustainable joint capability, interoperable with NATO, which enables the projection of UK Carrier Strike and Littoral Manoeuvre power as well as delivering humanitarian assistance and defence diplomacy, enabling joint effect across the maritime, land, and air environments at a time and place of political choosing”.

As such, CEPP seeks to maximise investment in the ships and the air ‘packages’ they can operate and support. Thus, while the primary focus remains on the embarkation of a fixed-wing heavy air group for carrier strike capabilities, the CONEMP also envisages the routine use of the QEC carriers as air manoeuvre platforms. That drives additional ship/helicopter operating limit clearances for battlefield and support helicopters, stowage plans for the air group, additional munition clearances, and an uplift in accommodation and supporting facilities for an embarked military force.

France

Commissioned in 2001, the French Navy’s sole aircraft carrier, the nuclear-powered 43,000-tonne-displacement Charles de Gaulle, is currently in the midst of a major mid-life refit and
modernisation at Toulon. Naval Group (previously DCNS) is performing the work in conjunction with the Direction Générale de Armaments and the French Navy’s Fleet Support Service.

France is the only nation outside the United States to operate a ‘cats and traps’ carrier. During its first 15 years of service, *Charles de Gaulle* has participated in a number of live operations, including Afghanistan, Libya, and most recently, the operations against Islamic State militants in Iraq and Syria.

*Charles de Gaulle* entered drydock in Toulon in February. The 18-month upkeep period, which is intended to ensure that the ship can remain in service for another 20 years, includes work to renovate the hull and platform systems, an upgrade of the ship’s aviation facilities to reflect the move to an air wing based on a single fixed-wing type (the Rafale M), and a major combat systems modernisation. The ship’s two K15 pressurised water reactors are also being refuelled.

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*Charles de Gaulle*, pictured in the Arabian Gulf in company with the US aircraft carrier USS Carl Vinson (CVN 70). (US Navy)

**Russia**

The deployment of the 27-year-old Project 1143.5 heavy aircraft-carrying cruiser *Admiral Kuznetsov* to the eastern Mediterranean in late 2016 to support the Russian intervention in Syria marked the first time that the ship had been employed in a live military operation and was seen as a highly visible demonstration of the Kremlin’s political intent.

However, the deployment also served to highlight the fragilities and shortfalls affecting Russian carrier aviation. Two aircraft – one Su-33 ‘Flanker-D’ and one MiG-29KR ‘Fulcrum’ – were lost at sea and a significant part of the air wing was flown off to operate from Humaymim Air Base in Latakia province.
It is a fact that Admiral Kuznetsov was not designed to embark a strike air wing – the ship’s offensive power lies in its silo of 12 P-700 Granit/SS-N-19 ‘Shipwreck’ anti-ship missiles – but rather to support fleet air defence.

The Russian government has repeatedly asserted plans to develop and build a new class of carriers, but the timeframe for such a significant investment remains clouded by defence funding shortfalls and industrial base issues. In May it was reported that the military-industrial commission convened to determine the 2018–25 State Arms Programme had decided to suspend development work on the future carrier project.

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