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CMSI Translations #11: Mid-Life Overhaul and Upgrade of the Type 052C Guided Missile Destroyer

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翻译

TRANSLATIONS

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Mid-Life Overhaul and Upgrade of the Type 052C Guided Missile Destroyer[1]

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Recently, in the super harbor where the aircraft carrier “Fujian” (hull number 18) was moored, we unexpectedly discovered the “Lanzhou” (hull number 170) covered with scaffolding. Compared with the "Fujian" and "Lhasa" ships (the second Type 055, 10,000-ton destroyer, hull number 102) moored in Qianyi, the "Lanzhou" ship is not eye-catching in terms of tonnage or advancement, but as the first ship of the Type 052C missile destroyer, the mid-life overhaul and upgrade of the ship is still quite interesting.

The construction of the Type 052C guided missile destroyer took a long time, and it was experimental in the sense of "taking small steps for rapid progress" (*xiao bu kuai pao*). In fact, it was also the engineering prototype of the standard fleet destroyer Type 052D. The first and second Type 052C ships were launched in April and October 2003, respectively. They were the most advanced guided missile destroyers of the PLAN at that time, but the subsequent four ships of the same type were launched in October 2010, July 2011, and January and July 2012, respectively.

During the construction of the Type 052C guided missile destroyer, the PLAN not only began to upgrade its old guided missile destroyers, but also prepared to produce the subsequent Type

[1] 巨浪 [Ju Lang], 052C 导弹驱逐舰的中修升级 [“Mid-Life Overhaul and Upgrade of the Type 052C Guided Missile Destroyer”], 舰载武器 [*Shipborne Weapons*], no. 397 (November 2022), pp. 45-54.

[2] **Translator’s Note:** Ju Lang (巨浪) is a pen name which means “giant wave.”

052D guided missile destroyers. The first Type 052D guided missile destroyer was officially launched in August 2012, only one month after the launching of the sixth Type 052C guided missile destroyer.

There is no doubt that the combat capability of the Type 052C guided missile destroyer is not as good as that of the Type 052D. Therefore, the status of the Type 052C is undoubtedly special, and changes in its technical status during its service have always attracted attention. Recently, someone updated a series of photos of the Jiangnan shipyard on a public Chinese internet platform, showing the work being done there. Three protagonists can be seen in this set of newly taken photos: one is naturally the "Fujian" aircraft carrier, which is still under outfitting and has attracted the most public attention; one is the Type 055 destroyer "Lhasa", which is moored on the harbor embankment with a yellow membrane on the deck and an operating platform built outside the "Star of the Sea" radar; and the other is the Type 052C missile destroyer "Lanzhou" in the floating dock with its superstructure covered with scaffolding. Judging from the photos, the "Lanzhou" ship in the floating dock is obviously undergoing a large project.

The PLAN's "Lanzhou," which has been set up with scaffolding in the floating dock, is obviously undergoing maintenance and upgrades.

As one of the first batch of Type 052C ships, the Lanzhou has been in service for 17 years since 2005. According to the traditional 15-year maintenance and upgrade rhythm of our military combat ships, although the "Lanzhou" is still a very new ship in people's minds, it has also reached the middle of its life span, and now it is obviously time for a mid-life overhaul and upgrade. So, what aspects will the mid-life overhaul and upgrade of the "Lanzhou" ship focus on? This is undoubtedly a topic of concern to people.

As China’s comprehensive national strength has improved, China's maritime strength has gradually grown, and its "maritime power" strategy has steadily advanced, causing strategic concerns for the United States. Although China has always firmly stated that it will take the path of peaceful development, and there is still a large power gap between China and the United States, from the perspective of development trends, the contradiction between China's "maritime power" strategy and the United States' "return to sea control" strategy is inevitable, and the compatibility of core interests has declined. The United States regards China as the most pressing

long-term strategic threat at sea and is wary of China’s maritime influence expansion into the "Indo-Pacific" region. As a result, the United States' maritime competition with China is intensifying.

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In fact, changes in the international balance of power are one of the main reasons for the adjustment of the United States’ maritime security policy. As China's comprehensive strength, especially its maritime strength, increases, its national maritime rights and interests have been relatively extended, and its ability to safeguard its own maritime rights and interests and participate in the construction of a maritime security order has been enhanced. This is bound to cause uneasiness and concern in the United States. In order to maintain its maritime hegemony, the United States' maritime competition with China has become more intense and targeted.

China has become the world's second largest economy and the world's largest trading nation. The leap in economic strength is the cornerstone of China's national strength. China's strength in the military and political fields is also increasing. Based on this, the United States' strategic anxiety has intensified. Unlike the Obama administration’s policy of “engagement + competition” toward China, the Trump and Biden administrations’ competitiveness toward China has become increasingly evident. In 2017, the Trump administration formally proposed that "great power competition is the main threat to the United States" and positioned China as the main competitor, emphasizing "whole-of-government" competition with China. During the Biden administration, China is viewed as "the only country in this century that can challenge the United States in all aspects" and [the administration] advocates all-round competition with China.

Focusing on the maritime domain, China's rapid growth in naval power has become a focus of attention for the U.S. government and military. The relative narrowing of the gap in maritime power between China and the United States has caused the United States to pay more attention to its dominant position in maritime power, and it has taken multiple measures to curb the growth of China's maritime power. The maritime competition between China and the United States is showing an intensifying trend. In fact, the maritime competition between China and the United States is the first time since World War I that the friction point between an emerging power and an established power has occurred at sea.

First, the United States is surrounded by the sea on three sides. It has used the ocean as a stage to develop a powerful navy and allies, establish maritime hegemony and extend it to the world, and thus, gradually become a world pole. There is no doubt that the United States pursues absolute security and control of the world's oceans. However, as China's national strength grows, moving towards the ocean and engaging in strategic management of the sea (*jinglue haiyang*) is inevitable.

Second, China and the United States do not share a land border; the ocean is the bond that connects the two countries, especially in the Pacific and Indian Ocean regions, where the interests of the two countries are intricately intertwined and their interactions are frequent. In the Western Pacific region, the balance of power between the Chinese and U.S. militaries has changed significantly, and there is a possibility of forming a situation of equal strength, thus becoming a hot spot of competition.

Since Biden was elected as the U.S. President, containment of China has intensified.

The PLAN's "Lanzhou".

Third, as major scientific and technological powers and resource-hungry countries, China and the United States both have the ability to develop and utilize the oceans, deep seas, polar regions, and other areas. However, the maritime strategic backgrounds, strategic cultures, and strategic traditions of China and the United States are very different, and the strategic contents are also different. The identities of a maritime hegemonic country and a late-developing maritime country determine that contradictions in the two countries' maritime strategies are inevitable. Against the background of the narrowing gap in maritime power between China and the United States, the contradictions between the two countries are more prominent.

It is in this context that the mid-life overhaul and upgrade of the “Lanzhou,” the first Type 052C missile destroyer, which is one of the most important of China’s iconic combat ships in its naval modernization process in the past 20 years, naturally attracts attention.

Main Combat Ships Become “Mainstream”—The Special Historical Role of the Type 052C

In the PLAN's current order of battle, the Type 052C missile destroyer has special historical significance. Before 2005, the overall condition of the PLAN was still very backward, and most of its surface ships had almost no naval combat capabilities in the modern sense. These ships lacked effective means of air defense and anti-submarine warfare, having basically no air defense or anti-submarine warfare capabilities to speak of. For example, the entire East China Sea Fleet had only four Type 956E/EM "modern" class missile destroyers and two Type 054 frigates as main combat ships with a certain combat capabilities.

The situation of the North Sea Fleet was even more stretched. It only had Type 052 missile destroyers of the 1980s level, with hull numbers 112 and 113. Its overall strength was far below that of the Second Escort Fleet of the Japan Maritime Self-Defense Force. The entire fleet was not enough to compete with a Japanese Maritime Self-Defense Force escort fleet. As for the South China Sea Fleet, the only ship that could hold the scene was the Type 051B guided missile destroyer "Shenzhen" (hull number 167).

The PLAN had only 17 ships that were truly capable of visiting foreign countries, and the combat capabilities of the other large number of surface ships were not as good as those of the local teams of the Japan Maritime Self-Defense Force. However, [Admiral] Liu Huaqing once said that our equipment has never been comparable to that of foreign armies, but we must never be a Chinese [people] who always keeps our heads down. As long as we focus on what we should do, we can stand tall and walk towards the world.

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The Type 051 destroyer equipped by the PLAN in the early days.

In fact, in 2005, the PLAN's surface ship force was at a historical point where it began to erupt after a long period of stagnation, and its symbol was the construction of the Type 052C missile destroyer. In the early 1980s, the PLAN's equipment base was very weak. The independently

developed Type 051 destroyer was limited by technology and industrial foundation and had no combat effectiveness for a long time after entering service. Its design standard was that of the Soviet Union in the 1950s. Except for anti-ship missiles, the level of other equipment was not much different from that of the destroyers during World War II. Air defense could only rely on ship cannons, and anti-submarine warfare could only rely on rocket-type depth charges. If the Type 051 destroyer was still somewhat useful in the 1950s and 1960s, it was no better than a missile boat in the 1980s.

The PLAN was well aware that the Type 051 destroyer was already behind the times and its air defense and anti-submarine warfare capabilities were almost nonexistent, so it planned to introduce advanced foreign equipment. First, it wanted to introduce the British "Sea Dart" missile (to transform the Type 051S destroyer) and the British Type 42 destroyer, but the layout and size of the Type 051 destroyer could not meet the requirements. Helplessly, the PLAN decided to develop a brand-new Type 052 destroyer based on the introduction of core technologies. The construction of the first Type 052 destroyer began in 1986. It took five years to launch and another three years of sea trials before it was commissioned. It was known as "China’s number one warship." Subsequently, the second Type 052 destroyer was also launched and commissioned.

In fact, starting with the Type 052 guided missile destroyer, the PLAN chose an economical and pragmatic development path for main combat ships such as destroyers. That is, to first build one or two immature models, and then start large-scale construction after the experiments matured. This is the so-called "small steps for fast progress" strategy.

In 2003, two Type 052B and two Type 052C guided missile destroyers were launched and commissioned from Jiangnan Shipyard. At the time, they were the so-called "Four Swordsmen of Jiangnan." The hull designs of the Type 052C and Type 052B were basically the same, or in other words, they simply shared the same hull (the Type 052B has very good center of gravity stability while sailing). It is for this reason that there was greater room for improvement.

Taking into account the installation of large radars, the bridge of the Type 052C missile destroyer was designed to be taller, and the full load displacement was increased by 400 tons, but the overall stability was reduced by 15 percent, yet this did not have a significant impact on navigation stability. The shipborne systems of the Type 052C made revolutionary progress compared with the Type 052B (the overall design of the Type 052B is relatively conservative, which is the responsibility of China with assistance from Russia. Its shipborne systems were mainly transferred from the Russian-made 956E/EM, that is, the "Sovremenny" class missile destroyer)—large-scale active phased array radar, stealth design, and vertical launch long-range surface-to-air missiles were a historic leap for the PLAN. The Type 052C marked China’s entry into the world's mainstream ranks in terms of domestically produced main combat ships at the destroyer level. In some aspects of technology, it even surpassed the US Navy's Aegis ships. This was of great significance to the PLAN, which had long lagged behind in the technology of its main combat ships, and even to the entire national defense situation of China.

In key technologies, the Type 052C was one generation ahead of the Type 052B, with which it shares the same hull. Its main advantages were the installation of a phased array radar system and a "Haihongqi" 9 vertical launch system. The advantages of the vertical launch missile system are that the launch silos are compactly arranged and have a large missile load; second, the ship does not need to turn when attacking the target, and can carry out all-round strikes; third, the missile launch device is located below the deck, which can lower the center of gravity of the ship and is also conducive to stealth. Compared with the Type 052B, the Type 052C has more than 60 percent new technologies, but too many new technologies made the first batch of two Type 052Cs less mature.

The "Lanzhou" is conducting tactical maneuvers at sea. Its black hull number shows that it is in its early service state.
A close-up of the antenna array of the active phased array radar of the Type 052C destroyer (right picture).

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For example, although the Type 346 four-sided active phased array radar equipped on the ship was the world's first mass-produced S-band swept phased array radar (called the "Dragon's Eye" in the West), the early Type 346 radar was immature in terms of technology, design, software and procedures. Due to material limitations, the detection range of the T/R module of the Type 346 radar was only over 300 kilometers. In comparison, the detection range of the T/R module of the AN/SPY-1D unswept phased array radar of the US Navy's "Burke" type 1/2 destroyer is 490 kilometers. Moreover, the Type 346 active phased array radar had a short testing cycle and defects in the data processing software, resulting in a low signal-to-noise ratio, large wave velocity interference, and serious near-shore clutter interference, which seriously affected the detection results.

In addition, due to the insufficient tonnage of the ship, the vertical launch system of the Type 052C destroyer had only 48 launch units and could only be equipped with the "Haihongqi"-9 medium- and long-range air defense missiles.

Due to various deficiencies, the PLAN did not continue to build the Type 052C, but instead focused on solving existing problems. This means that although the Type 052C is a generational advancement in technology, it is still a transitional experiment in the "small steps and fast

progress" strategy. The first batch of two Type 052C ships, including the “Lanzhou,” entered service in 2005. However, it was not until 2011 that a series of problems such as data processing and signal data tampering of the Type 346 phased array was solved, forming a complete combat capability. At this time, the design of the Type 052D, a technically improved version of the Type 052C, had already been completed. The hull and layout of the Type 052D are very similar to the Type 052C, and the length is basically the same as the Type 052C destroyer. Only the width is slightly increased, and the full load displacement is increased by 300 tons. However, the superstructure and shipboard systems are significantly different.

Compared with the Type 052C, which has its helicopter hangar on the left side of the ship, the Type 052D hangar was moved to the center of the ship. The ship’s small boats, which were originally located on the side deck in the open air, were moved into the enclosed compartments on either side of the helicopter hangar. Long flat antennas for data transmission were added on both sides of the top of the bridge. The rear vertical launch equipment was moved from parallel to the hangar to in front of the hangar, the rear mast was also moved forward, and a window for retracting and extending the towed array sonar was added to the tail.

There were also significant changes in shipborne weapons. The 100mm single-barreled naval gun of the Type 052C ship was replaced by a new 130mm single-barreled naval gun. The two [Type] 730 short-range anti-missile naval guns were also replaced by a close-in defense system composed of one [Type] 730 short-range anti-missile naval gun and a 24-cell "Red Flag" 10 short-range anti-missile missile system. This "missile-gun combination" anti-missile system can intercept multiple anti-ship missiles within a range of 500 meters to 10 kilometers. It is not limited by the number of fire channels, and its inner short-range anti-missile capability is unmatched by the Type 052C.

The 6-cell vertical cold launch system of the Type 052C did not solve the problem of universalization. The new vertical launch system used in the Type 052D type had 16 more cells, and its structure was similar to that of the U.S.’s MK41 vertical launch system. Its diameter reaches 0.85 meters, which is larger than the 0.63 meters of the MK41 and the 0.71 meters of the newly developed MK57 vertical launch system of the United States. Its length was increased to 9 meters, which is also larger than the 6.7 meters of the MK41 and the 7.9 meters of the MK57. It can carry 48 surface-to-air missiles and intercept 20 to 25 air targets. The remaining launch cells are compatible with 16 anti-ship missiles or anti-submarine missiles, and it also has the potential to install 2-4 small launch boxes in one unit. It is expected that the number of ship-borne missiles carried will be increased exponentially.

Aerial view of the Type 052D destroyer of the PLAN.

Missile vertical launch system at the forward of the Type 052D destroyer.

Of course, the biggest change from the Type 052C to the Type 052D was the upgrading to the Type 346A active phased array radar, which won the National Science and Technology Progress Award. The Type 346A active phased array radar eliminates the curved radar antenna cover [needed] on the Type 346, changing from air cooling to liquid cooling, with better effect. When the radar is working, the head generated by the components is like thousands of induction cookers. If the radar is turned on for a long time, the air-cooled Type 346 phased array radar is more likely to overheat and shut down or even burn out. The purpose of the curved antenna cover is to have more powerful static pressure wind power. Liquid cooling only needs to lay out water-cooling pipes with different densities. The curved antenna cover is no longer needed. This increases the antenna area by nearly 20 percent, changing from rectangular to square. The number of T/R components was increased to 5,700, thereby significantly increasing the detection range. The radar control system applies digital beam control, which greatly enhances the detection capability and accuracy. The analog components on the Type 346A were also replaced with digital, fully solid-state components. The ability to work continuously for a long time was

improved. Due to the fact that the radar is installed at a fairly low position, its low altitude search capability is poor, so the Type 052D destroyer is equipped with a Type 364 low-altitude search radar.

The Type 052D has higher technical specifications and a more mature

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design than the Type 052C. It is a truly standard fleet destroyer that can be mass-produced. However, considering that there may be a combat power gap before the Type 052D ships built in batches could become combat-ready, the PLAN built four second-batch Type 052C ships, namely, the No. 150 "Changchun," No. 151 "Zhengzhou," No. 152 "Jinan," and No. 153 "Xi'an."

The PLAN Type 052C destroyer “Xi’an”.

The PLAN Type 052C destroyer “Zhengzhou” at the shipyard.

In fact, the first ship of the Type 052D guided missile destroyer (that is, the "Kunming" ship, with hull number 172) was launched on August 30, 2012, only about a month later than the fourth ship of the second batch of Type 052C guided missile destroyers (that is, the "Xi'an" ship, hull number 153). But even so, it still cannot change the transitional nature of the Type 052C ship. Therefore, in the current order of battle of the PLAN, the Type 052C missile destroyer is a special small group. It is not only a totem that once marked the cross-generational progress in the technical quality of main combat ships, but a semi-mature equipment that needs to be adjusted and supplemented at the appropriate time to cope with complex military struggles.

Between Ideal and Feasible: Mid-Life Overhaul and Upgrade of the Type 052C Guided Missile Destroyer

The normal service life of PLAN ships is generally estimated based on the tonnage of the ship, and the service life of a ship is generally consistent with its design life. From the 1990s to the beginning of this century, China's naval vessels were in service beyond their service life on a large scale. This was directly related to the inability to build new ships due to insufficient funds at the time. This situation has now been reversed, especially in terms of combat ships. The number of ships in service beyond their service life has been greatly reduced. Whether a ship is retired early or serves beyond its service life, it needs to be analyzed and demonstrated in

combination with its technical lifespan and economic lifespan, and a decision can only be made after comprehensive analysis and testing.

For destroyers 5,000 tons or above built after the 21st century, the PLAN has scheduled their service life to be 30 to 35 years. However, the service life of the ship is calculated from the time it is delivered for use, and the service life depends on many factors such as the technical level of the national shipbuilding industry, the structural strength of the ship, and the wear and tear, and is directly related to later repairs and maintenance.

Maintenance of ships is a necessary means to ensure their good condition during their service and is one of the direct guarantees of their combat capability. PLAN ship maintenance is divided into unplanned maintenance (*linshi weixiu*) and planned maintenance (*jihua weixiu*). Unplanned maintenance is non-preventive repair of ship failures, damage, and battle damage. Planned maintenance is a regular task of dismantling and repairing ships at regular intervals according to their service life. The PLAN's planned repair levels for ships include dock repair, minor repair, medium repair, and major repair.

Dock repair, also known as dock maintenance, is the regular entry of ships into the dock for inspection and maintenance. It can also be carried out on the slipway. The purpose is to remove debris and rust from the underwater part of the ship and to maintain and repair mechanical and electrical equipment.

Minor repairs are local preventive dismantling and repairs of the hull and various equipment after the ship has been used for a certain number of years. The purpose is to maintain it in normal technical condition before the next repair.

Mid-life overhaul is a comprehensive preventive dismantling and repair of a ship to restore it to its original state and maintain its original performance. The scope and workload of the mid-life overhaul are larger, and the implementation period is also longer.

A major overhaul is a comprehensive inspection and repair of a ship to fully restore its original performance. However, due to the characteristics of mechanical and electronic equipment, this is almost impossible to achieve, so usually only two mid-life overhauls are carried out during the life of the ship.

Generally speaking, the purpose of mid-life overhaul of combat ships is to restore all systems of the combat ship (especially the power system) to their optimal condition. This would be considered a passing score for the mid-life overhaul of combat ships. No matter how well a combat ship's daily maintenance is done, it is impossible to avoid problems such as fatigue damage to the hull and wear of power system parts over the years (the wear and tear damage to the hull mainly comes from the periodic changes in the internal structural stress of the hull caused by the periodic changes in wave loads when sailing in the sea).

Mid-life overhaul requires inspections and repairs related to these issues, such as a comprehensive inspection of the combat ship, and then repairs if necessary: if wear and tear damage is found in a certain location, the relevant area must be cut out (*qiege*) according to specifications and new steel plates must be welded on; if the power system is found to be aging,

it may be necessary to open up the combat ship and replace the entire engine and gearbox, and so on. At the same time, [the purpose of] mid-life overhaul of combat ships is also to enable

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the combat ships to better cooperate with existing combat systems. This would be an outstanding score for mid-life overhaul of combat ships. For example, modernizing and upgrading the ship's hardware and software such as radar, sonar, data link, computers, and ordnance to enable the combat ship to better adapt to its role in the existing combat system (rather than changing its role).

The PLAN usually carries out modernization work simultaneously with the ship's overhaul. This not only avoids duplication of construction and reduces engineering workload, but also further improves the ship's combat performance.

The "Lanzhou" and "Haikou" ships are both "pioneer ships" among the Type 052C missile destroyers. [They were] the first high-performance air defense missile destroyers of the PLAN to have reached the world's advanced level, [but] the early Type 346 phased array radar did not perform well on the two ships, resulting in the subsequent "Changchun," "Zhengzhou," "Jinan," and "Xi'an" ships not being put into service until eight years later. Taking into account that the first ship of the second batch, the “Changchun,” has only been in service for nine years, the opportunity to make technical upgrades during mid-life overhaul must start with the “Lanzhou” and “Haikou” ships, which have been in service for 17 years.

From a technical point of view, the goal of the technical upgrade of the Type 052C missile destroyer is of course the "Type 052D." The Type 052D has a wider air defense interception range. After all, it is equipped with a Type 346A radar with a longer detection distance and the longer-range "Haihongqi" 9B air defense missiles. Moreover, the Type 052D's cold and hot co-mounted missile vertical launch system can launch various types of missiles, such as anti-ship, cruise, and anti-submarine, in addition to air defense missiles. This is incomparably [better] than the Type 052C, which can only launch the "Haihongqi" 9 air defense missile. But considering the reality of the Type 052C, is it feasible to completely transform it into the Type 052D during the mid-life overhaul? This is worth discussing.

On the positive side, with the development of China's electronic technology, the mass production of the Type 052D and Type 052DL has made the manufacturing technology of Type 346A phased array radar more mature, and the production cost has been greatly reduced. Moreover, the early Type 346 radar of the Type 052C and the late Type 346A radar of the Type 052D, as well as the hulls of the Type 052C and the Type 052D, are all of the same lineage. After all, the Type 052C is the early prototype of the Type 052D. In other words, most of the shipborne equipment currently used by the PLAN on the Type 052D missile destroyers (including 346A active phased array radar) can be transplanted to the Type 052C missile destroyers. In other words, it is theoretically feasible to upgrade the Type 052C to a combat capability similar to that of the Type 052D. Moreover, in terms of the amount of modification work and modification costs, this seems to be much smoother than modifying the "Sovremenny" class.

The PLAN Type 052C destroyer "Haikou".

The "Haikou" ship docked at the pier.

However, it is not easy to realize the ideal of taking advantage of the mid-life overhaul opportunity to “upgrade” the Type 052C to the Type 052D. In other words, if many detailed issues are opened up, things will become complicated. For example, the replacement of the shipborne large phased array radar system not only involves the radar antenna array, but also involves the power supply capacity of the ship and the layout of the cooling system pipeline. This is a very complicated task. To solve the power supply problem of the Type 346A phased array radar, the Type 052C missile destroyer should either use a more powerful power pack (*dongli bao*) or add a power generation device. In any case, the hull of the Type 052C must be cut and adjusted significantly, which is a lot of work.

In addition, when phased array radar is equipped on modern high-performance main combat ships, special consideration should be given to the installation height and installation angle, which involves the detection range of the radar. Therefore, the complexity of upgrading the Type 052C's shipborne radar from the Type 346 to the Type 346A is "more" than expected.

Generally speaking, the hulls of the Type 052C and Type 052D missile destroyers are not very different, but strictly speaking, there are still differences. For example, the length of both ships is

156 meters, but the width of the hull is slightly different. The hull width of the former is 17 meters, while the width of the latter is slightly increased to 18 meters in order to improve ocean-going seaworthiness and expand the internal space of the hull. Behind this difference in the hull is a considerable change in the shipborne systems of the two. Different hull widths mean that the structural framework of the hull platform is also different.

In fact, the Type 346A radar quad-array antenna installed on the Type 052D is quite different from the Type 346 radar equipped on the Type 052C in terms of the number of T/R units, heat dissipation structure, size, and weight, so the superstructure where the radar antenna is installed has been adjusted in terms of shape, size, and outer wall inclination angle. This means that it is not realistic to transplant the Type 346A radar on the Type 052D to the Type 052C intact.

In addition, one of the defects of the Type 052C, which is considered a "disease," is the poor compatibility of its cold vertical launch s with different types of ammunition, which is in sharp contrast to the 64-unit hot and cold universal vertical launch system equipped on the Type 052D destroyer. The Type 052D's hot and cold universal vertical launch system was developed

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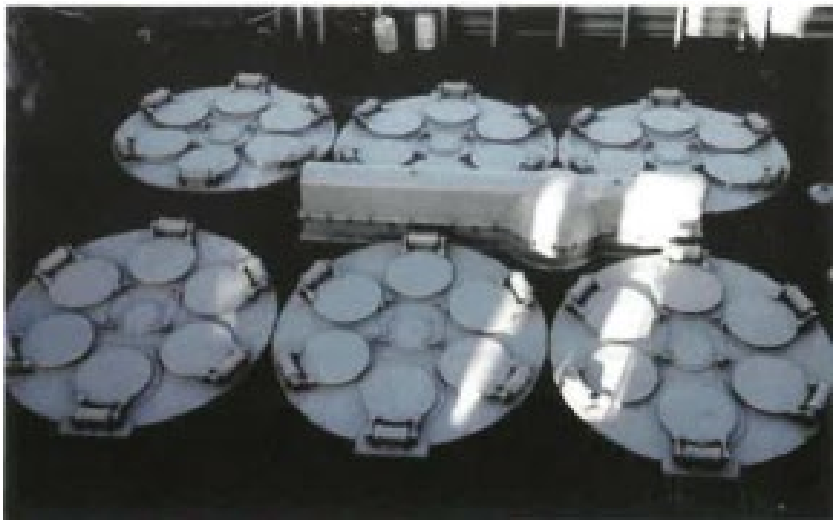
in accordance with the national standard "General Requirements for Surface Ship Universal Vertical Missile Launching Devices," which features a larger diameter, deeper depth, and a stronger degree of modularity.[3] Part 6 of this standard stipulates that "the diameter of the storage and transportation launch tube should not exceed 850 mm."



A close-up of the vertical launch system of the Type 052C destroyer. Compared with the universal vertical launch system of the Type 052D destroyer, the vertical launch system of the Type 052C destroyer obviously lacks compatibility.

In comparison, the MK41 vertical launch system of the U.S. Navy's "Burke" class destroyer is 635 mm, and the latest MK57 vertical launch is 710 mm. The vertical launch system of the Type 052D destroyer is not only large in size, but also adopts a modular design, divided into three

[3] Translator's note: The Chines name for the standard is "水面舰艇导弹通用化垂直发射装置通用要求."

modules: "large," "medium," and "small." The large module is 9 meters deep, the medium is 7 meters deep, and the small is 3 meters deep.

At present, the 9-meter module of the Type 052D is equipped with the "Yingji" [YJ]-18 anti-ship missile, which takes up the most space; the medium-sized 7-meter module is equipped with the "Sea Red Flag" 9B, which has a slightly shorter body. According to the requirements of Article 5.1.3 and Article 5.2.4 of the [abovementioned] standard, the vertical launch of Type 052D is composed of eight launch units, each of which can be equipped with four types of missiles: air defense, anti-ship, anti-submarine, and land attack, and supports "one pit and four missiles" (*yikeng sidan*). In other words, in theory, in the future it can also be compatible with medium-range air defense missiles similar to the US Navy's "Improved Sea Sparrow," thereby greatly enhancing and expanding the ability of the Type 052D to perform diversified tasks.

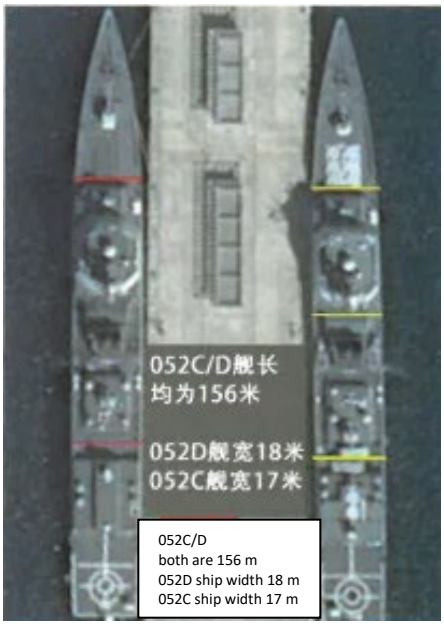
However, it is very complicated to completely upgrade the vertical launch system of the Type 052C to the standard of the Type 052D. If we only consider the replacement of the forward weapon module of the Type 052C missile destroyer, then this problem is not big. After all, the forward vertical launch area of the Type 052C and the Type 052D is similar, and the engineering volume of the Type 052C forward to use the Type 052D specification hot and cold compatible universal vertical launch system is relatively small. The problem is that there are two 6-unit vertical launch devices in front of the helicopter hangar at the rear of the Type 052C, which happens to be the densely populated area of the ship. If it is to be modified, the hull must be cut significantly. The engineering volume and actual cost of this improvement are similar to the cost of adding a brand-new Type 052D, but what is obtained is a refurbished ship with a remaining service life of less than 20 years, which is obviously not worth the cost. Judging from the modification of the "Sovremenny" class and Type 052B ships, the PLAN has also been trying to avoid making major adjustments to the main structure of high-value platforms such as destroyers.

In fact, when it comes to the modernization and upgrading of high-value military equipment, all countries adhere to the principle of "moderation." For example, the combat effectiveness of different batches of the U.S. Navy's “Ticonderoga” class missile cruisers and “Arleigh Burke” class missile destroyers vary greatly, even more so than the difference between the Type 052C and the Type 052D. The early Burke-1 type did not even have a hangar (the Burke-1 is essentially an emergency transitional ship), but during its service life, the U.S. Navy did not seek complex engineering modifications and upgrades such as adding hangars and changing the hull structure during its mid-life overhaul. This is the result of comprehensively considering factors such as the remaining service life of the ship, modification costs, cycles, etc.

In the above sense, the most critical issue for the technical improvement and upgrade of the Type 052C is how to grasp the degree: if it is to be "upward compatible" and forcibly changed to a "standard ship" of the Type 052D level, the project will be too huge, and it is better to build a new one than to rebuild it; and if it is to be "downward compatible" and move it closer to the level of the Type 054A, then the combat effectiveness of the Type 052C will become weaker and weaker. Therefore, some people believe that the feasible and reasonable solution for modernizing the Type 052C missile destroyer is a compromise of "changing the head but not the tail." That is

to say, the Type 346 phased array radar on the Type 052C will be partially upgraded according to the technical standards of the Type 346A, mainly in the updating and replacement of T/R modules, cooling system, and rear-end cabinets; but the building structure, energy consumption, and matching of the original hull of the Type 052C should be kept unchanged as much as possible. In this way, not only is the construction workload of the ship's superstructure smaller, but the rear power compartment also does not require major changes.

In fact, taking advantage of the opportunity of mid-life overhaul, it is entirely possible for the Type 052C to obtain better sensor capabilities than the Type 052D within a relatively limited work plan. Although the Type 346A phased array radar is a significant improvement over the Type 346, it was developed in the late 1990s. At that time, China's semiconductor level was limited, and it had to use mature silicon bipolar tube materials to



The hull size of the Type 052C and the Type 052D are different, which means that the Type 052C cannot be modified to the Type 052D standard.

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manufacture T/R modules. It achieved higher combat performance by relying on the swept working system and large-size antenna array. Unless the T/R module is replaced, its performance can no longer be improved. The power capacity, density, operating frequency band, output power, signal-to-noise ratio, and thermal/electrical conductivity of gallium nitride materials are better, greatly improving the performance of phased array radars; and gallium nitride materials have improved it immensely. Fortunately, in recent years, China's gallium monoxide and gold chloride materials have made great strides.

The 6 by 6-unit vertical launch systems at the forward of the Type 052C can also be replaced with 32-unit hot and cold universal vertical launch systems of the Type 052D specification with a relatively small amount of engineering work. As for the rear half of the hull, the engineering work of replacing the original cold vertical launch with a hot and cold universal vertical launch

system is too large, so it seems that it is better to "keep it unchanged." But even so, the Type 052C can increase its ammunition carrying capacity and be compatible with various heterogeneous ammunition types from anti-submarine to land attack, expanding its mission scope to a considerable extent and achieving the expansion from a relatively pure air defense destroyer to a more balance multi-purpose warship.

Moreover, the original cold vertical launch device of the Type 052C is completely different from the Russian imported "Rif"-M rotary air defense missile vertical launch system (China has imported two sets of "Rif"-M systems from Russia, equipping two Type 051C missile destroyers). It does not require rotation for launch, and each launch unit can launch independently and in groups continuously.

As a product of China's 100 percent independent development, if this device is to be compatible with the "Hongqi" 9B air defense missiles, which has a significantly increased firing range (*shecheng*) and firing envelope (*shejie*), the engineering volume and difficulty will be relatively small. After all, there are a total of six Type 052C ships in the two batches, so appropriate investment in this will still have economies of scale.

In addition, from the perspective of relatively small engineering volume but relatively large benefits, the feasible technical upgrade content of the Type 052C type may also include: replacing the Type 730 short-range anti-missile naval gun at the stern with a 24-unit "Hongqi" 10 short-range point air defense missile; replacing the Type 517HA meter-wave warning radar with a Type JY-27HA meter-wave warning radar, replacing the two 4-unit "Yingji" [YJ]-62 subsonic anti-ship missile tilted launchers with two four-unit "Yingji" [YJ]-12 supersonic anti-ship missile launchers, etc. Upgrading the "Yingji" [YJ]-62 subsonic anti-ship missile to the full-range supersonic "Yingji" [YJ]-12 anti-ship missiles will greatly improve the anti-ship combat capability of the Type 052C due to the greatly improved penetration efficiency of the latter. At present, the core mission of the PLAN in surface warfare is still to prioritize anti-ship warfare. Referring to the improvement strategy of the Type 051B, these Type 052B, Type 051C, and Type 052C ships are equipped with "Yingji" [YJ]-12 supersonic anti-ship missiles during the modification. This is very necessary to be the core firepower of surface anti-ship operations in the task force. The Type 730 short-range anti-missile naval gun on the rear helicopter hangar [should be] replaced with "Hongqi" 10 short-range point air defense missiles. On the one hand, it can improve the short-range air defense capability of the Type 052C, and on the other hand it can free up more operating space for the helicopter hanger. If the modification is appropriate, it is not impossible for the Type 052C ship to be equipped with the carrier-based version of the Z-20.

The active phased array radar of the Type 052C may be the focus of the Type 052C destroyer modification and upgrade.

Two quad-mounted “Yingji” [YJ]-62 anti-ship missile launchers on the Type 052C destroyer.

As for replacing the Type 517HA meter-wave warning radar with the Type JY-27HA meter-wave warning radar, it is also twice the result with half the effort. The meter-wave radar on the Type 052C/D works in the VHF band, and its maximum detection distance is similar to that of the Type 346/346A phased array radar. The reason for installing such a large meter-wave radar is mainly because the Type 346/346A, as a shipborne active phased array radar, has problems such as high-power consumption, high operating costs, and difficult maintenance. In addition, due to the confidentiality of the signal spectrum, the Type 346/346A is not suitable for long-term operation to perform long-range air defense missions.

Although the shipborne meter-wave radar seems to be outdated at present, its detection range is long distance, it can process a large number of serial targets at the same time, and the whole machine has low power consumption and long life. Due to its long service life, high-cost effectiveness, and ability to work continuously for 24 hours without interruption, it can play a very good role in complementing the “Big Shield” in shipborne phased array radar. When not working, it takes on the task of long-range alert at medium and high altitudes with minimal investment and cost. This can provide the entire fleet with basic long-range air defense alert capabilities. Moreover, although the accuracy of the Type 517 meter-wave radar is slightly lower

and it cannot directly guide surface-to-air missiles to perform air defense combat missions, once it detects an incoming target, it can immediately summon a more advanced phased array radar to start working and the “Big Shield” will take over the next step of air defense operations.

A similar example is the U.S. “Ticonderoga” class cruiser, which installed an AS/SPS-49 two-dimensional long-range air search radar in addition to the AN/SPY-1 phased array radar, also for a similar purpose. Moreover, meter-wave radars are naturally endowed with certain anti-stealth capabilities. This type of radar is rarely seen on other countries’ newly built advanced warships, but it appears on the most advanced surface warships of the PLAN. This is due to the needs of China’s special national conditions. After all, our strategic

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competitor is equipped with the world's leading fleet of stealth fighter jets. Combat effectiveness will be very different depending on if we are prepared or not.

A close-up of the Type 052C destroyer's operational radar.

The extended version of the Type 052DL destroyer is equipped with a new meter-wave radar.

In addition, meter-wave radar has another major advantage: it is less affected by the external meteorological environment. For example, when encountering high sea conditions or severe weather conditions, the detection efficiency of ordinary shipborne microwave radars will be

greatly attenuated, while the signal loss of meter-wave radars is much smaller and almost unaffected, which is also very important for surface ships' maritime operations.

From the perspective of the upgrade of the Type 052C destroyer, the Type JY-27HA meter-wave warning radar is the latest version on the Type 052D improved destroyer (the so-called Type 052DL). Compared with the Type 517 radar equipped on the early batches of Type 052C and Type 052D, the biggest change of the Type JY-27HA is the radar antenna structure. The Type 517 radar with a Yagi antenna is a dual-coordinate radar that can only measure the distance and azimuth of the target. In addition to measuring the distance and azimuth of the target, the Type 052DL JY-27HA can also measure the pitch angle or height of the target and can be used for target tracking and even for fire control guidance.

In fact, according to public information, the Type JY-27HA shipborne meter-wave radar has higher sensitivity, more flexible beamforming, and stronger anti-interference ability. The radar adopts the maximum likelihood altimetry method, which improves the target altitude information and data accuracy, and can command and guide fighters (especially "meeting the combat needs of fifth-generation aircraft warning and guidance"). The partitioned independent beam conformal method not only achieves better spatial coverage, but also can continuously obtain air situation information, solving the two problems of insufficient low-altitude performance of traditional meter-wave radars and the inability to continuously grasp air situation information.

Conclusion

As one of the signs that the PLAN has made great strides into the modernization process, the mid-life overhaul of the first Type 052C ship has special significance in the current environment and sends a complex signal. The implication is that China's preparations for responding to maritime pressure are in a state of "tightening up." Although the PLA is not strong enough to challenge the U.S. military superiority on a global scale in the foreseeable future, a more balanced distribution of power is replacing the U.S.-dominated unipolar structure in the Asia-Pacific region. As often mentioned in the international strategic community, the power transfer between China and the United States is taking place in the Asia-Pacific region, especially in East Asia.

Some relatively cautious and conservative views believe that China's rise at sea will bring about limited but substantial changes in the power structure, and believe that “over the past half century, the United States has generally maintained its dominance in Asian waters, but China is challenging this dominance.” It is worth noting that the United States has not yet adapted to this power transfer. Although the United States recognizes the changes in the balance of power in the Asia-Pacific waters, it refuses to share power: “Today's security environment is completely different from the strategic situation we have been accustomed to in the past 25 years, which requires new thinking and actions.”[4] The United States realizes that China has become a major

[4] **Translator’s Note:** This is a quote by former US Secretary of Defense Ash Carter. The original English quote is “Today's security environment is dramatically different than the one we've been engaged in for the last 25 years and it requires new ways of thinking and new way.” The original transcript can be found here: Secretary of Defense Ash Carter, “Remarks by Secretary Carter on the Budget at Economic Club of Washington, D.C.” *U.S. Department of*

maritime power and opponent in the Asia-Pacific region, so it has become extremely anxious and tried to suppress China from the strategic, tactical, and operational levels.

In general, the U.S. strategic competition with China in the South China Sea and other adjacent waters is aimed at “ensuring a regional balance of power that is favorable to the United States.” Although China has so far avoided using "strategic competition" to define the relationship between China and the United States in the South China Sea and other related waters in its official statements, the problem is that although China has no strategic intention to challenge the United States, China's rights protection actions and power building in the South China Sea and other related waters are seen by the United States as challenges to its dominant position in the Asia-Pacific maritime region. In the eyes of the United States, the rise of China's power itself is a change to the status quo. Even if China's rise is peaceful now, there is no guarantee that it will remain peaceful.

The way to avoid this uncertainty is what the United States has been doing for more than a century, that is, preventing other powers from controlling or dominating the ocean. Therefore, aside from the sovereignty and maritime rights and interests of the South China Sea islands, China has not yet announced its strategies and policy goals for other relevant waters, but it is clear that as its comprehensive strength increases, China will continue to increase its presence in the surrounding relevant waters and strengthen its maritime rights protection actions to enhance its regional influence.

Sino-U.S. strategic mutual trust is very low, and both sides believe that the other side is establishing an exclusive ocean order against itself. Therefore, competition between China and the United States in relevant waters is inevitable and will continue to escalate. Against this backdrop, China's military is upgrading the Type 052C main combat ships, which have a certain service life but are not outdated in terms of technical performance. This obviously means that China's understanding of the severity of the maritime military struggle is objective,

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cautious and pragmatic.

Defense (February 2016) https://www.defense.gov/News/News-Trans/Tran-View/Article/648901/remarks-by-secretary-carter-on-the-budget-at-the-economic-club-of-washington-dc/.

Recently, the US Navy has continuously sent aircraft carrier strike groups to show off its military power in the South China Sea.

China has built many Type 052D destroyers in recent years, which has greatly enhanced the strength of the PLAN's surface ships.

In addition, the mid-life overhaul and upgrade of the first Type 052C ship also shows that the PLAN has complex ways and methods to make efficient use of its limited resources. In the past 20 years, the development speed of China's naval surface ships has attracted worldwide attention. This is a very amazing speed, but it is also a worrying speed. In the process of modernization, the PLAN not only needs to build a sufficient number of new ships, but also replace a considerable number of old ships, but such a high-speed construction is unsustainable. In other words, such a speed cannot be sustained throughout the service life of high-performance warships.

The service life of a modern warship is about 35 years. Take the Type 052D ship as an example. The first Type 052D is the "Kunming" ship (hull number 172), which was launched in August 2012. So far, 25 ships [of this class] have been built and put into service, and more sections are constantly appearing in the two shipyards of Jiangnan and Dalian, an average of three ships per year. The construction speed of the Type 054A frigate is similar. The first ship was put into service in January 2008. By January 2016, 21 ships had been put into service, also close to three ships per year. The construction of the Type 054A was briefly suspended after 2020 but resumed

in 2021. If construction continues at this rate, Jiangnan alone would build 120 Type 052Ds or equivalent follow-up classes in 40 years, plus more than 100 Type 054As or equivalent follow-up classes. This is certainly not possible.

The PLAN Type 052C destroyer "Jinan".

The navy is a very expensive military service, accounting for a large part of the national defense budget. Large-scale shipbuilding is a huge investment, which has a huge impact on the total budget. In terms of the budget cycle, centralized shipbuilding is also disadvantageous. Not only does centralized construction require huge investment at once, but there are also problems of centralized docking and overhaul and final centralized decommissioning, which will cause large fluctuations in the navy's budget, and this is not conducive to investment and production capacity, and not conducive to the application of new technologies. “Cash is king” and “once you miss it, you will never get it again” reflect short-term thinking that is harmful to the sustainable development of the navy (and other businesses). The correct approach should be orderly and stable development, rather than disorderly and uncontrolled large fluctuations. While reasonably arranging the shipbuilding plan, we should also pay attention to the extension of the service life of the active ships and the "freshness" of the combat technology standards. Separating the construction, overhaul, upgrade, and decommissioning cycles in an orderly manner is conducive to budget stability, which is an important part of sustainable development.

In fact, due to the rapid changes in the international situation, the military budgets of many countries have increased significantly in 2022. China's military budget is about 1450.45 billion yuan, an increase of 7.1 percent over 2021, and the growth rate has been adjusted up by 0.3 percentage points over last year. However, China's military expenditure accounts for only about 1.3 percent of GDP, while the military expenditures of the United States and Russia in the same period accounted for 3.74 percent and 4.26 percent respectively, so the gap between China and China is not difficult to imagine. Since 2021, China has successively introduced relevant systems such as the "Interim Regulations on the Supervision and Management of Military Equipment Procurement Contracts," "Regulations on the Testing and Identification of Military Equipment," and "Regulations on the Order of Military Equipment," which regulate equipment ordering, marking the beginning of the overall optimization of the use of China's defense budget in terms of structure. Therefore, the way, standards, and specifications of the six Type 052C ships that have begun to be repaired and upgraded one after another are regarded as a weathervane for how the PLAN can efficiently use limited resources to improve the country's maritime capabilities.

As a symbol of the modernization process of the PLAN in the past 20 years, the mid-life overhaul of the first batch of Type 052C guided missile destroyers is bound to attract attention. After all, the PLAN needs to compete with the most powerful sea and air forces on earth. How to use limited resources as efficiently as possible to improve competitiveness is the key. China is still in a transition period from its surrounding areas to the world. A peaceful and stable surrounding environment is an important guarantee for China to extend its strategic opportunity period and seek new development. The ocean is an important direction for China to enhance its national strength and take the path of peaceful development. Maintaining and improving the surrounding maritime security environment is an inevitable choice for China's peaceful rise.