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RENAISSANCE STRATEGIC ADVISORS

Global Armoured Vehicle & Naval Markets

Trends, Drivers and Outlook for 2023 and Beyond

Featuring Client Spotlight on RENK Group AG

Background

This report on the Global Armoured Vehicle & Naval Markets is part of RSAdvisors series of occasional papers on topics of interest to stakeholders in defence and related technology markets. In addition to providing a comprehensive overview of one of the most attractive segments in the defence and security sector, this publication is unique for RSAdvisors in that it includes a special section on the transmissions, gear units, engines and suspensions market that is funded by our client, RENK Group AG, one of the largest transmission suppliers in the world. This feature examines the transmissions, gear units, engines and suspensions market and the size and growth rate of RENK's addressable portions. Readers are encouraged to read the Disclaimer section for important caveats regarding the information and estimates contained herein.

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Overview of RENK

RENK Group AG ("RENK") is a provider of drive solutions that set military armoured vehicles, naval vessels and machinery in motion. Customers include global defence, energy and industrial companies and government entities. RENK operates its business within three segments: Vehicle Mobility Solutions (VMS), Marine & Industry (M&I) and Slide Bearings (SB). This White Paper focuses on RENK's defence products, customers and positioning with the VMS, M&I and Slide Bearings segments, which accounted for ~70% of the company's revenue in 2022. RENK's offerings integrate RDT&E, production, maintenance and overhaul of drive systems. Specifically, the company provides transmissions, gear units, power-packs, engines hybrid propulsion systems, suspension systems, slide bearings, couplings and test systems.

Global Defence Environment

Threat Environment

The threat landscape facing the global community has expanded in terms of the number, diversity, and complexity of the challenges that nation states and multi-lateral organizations must address. The number of active conflicts in the world continues to rise, with over 184 as of 2022 spanning across state and non-state conflicts in addition to internal violence and state repression.[1] The nature of these conflicts is also changing as the delineation between state-based and non-state-based actors becomes less clear.

At the forefront of this evolving threat environment is the return of a conventional military threat from both China and Russia. Both of these states are investing in conventional force projection capabilities while adopting adversarial stances towards the US and its allies. This dynamic is reinforced by the rise of new technologies such as directed energy, hypersonics, offensive cyber systems, and electromagnetic spectrum weapons that have the potential to materially alter the current conventional balance in military capabilities.

Beyond the rise of China and Russia as near-peer adversaries, there is a wide range of active conflicts ongoing across the globe. Conflicts in the Sahel, Syria, Libya, and Yemen continue to be active with a range of local and international actors operating within these warzones, thus creating significant potential for these conflicts to spill over into neighbouring countries.[2] The deterioration of the situation in Afghanistan following the US withdrawal has shown how quickly states can be destabilized through an insurgency campaign, and have highlighted the fact that even current modern military capabilities are not necessarily sufficient to maintain security within politically destabilized areas.

The invasion of Ukraine by Russia in early 2022 has brought to the fore the threat of conventional warfare on the European landmass once again, driving a reappraisal of defence policy and spending within NATO and key Western allies (see figure 1).

[1] Uppsala Conflict Data Program, www.ucdp.uu.se
[2] https://press.un.org/en/2023/sc15184.doc.htm

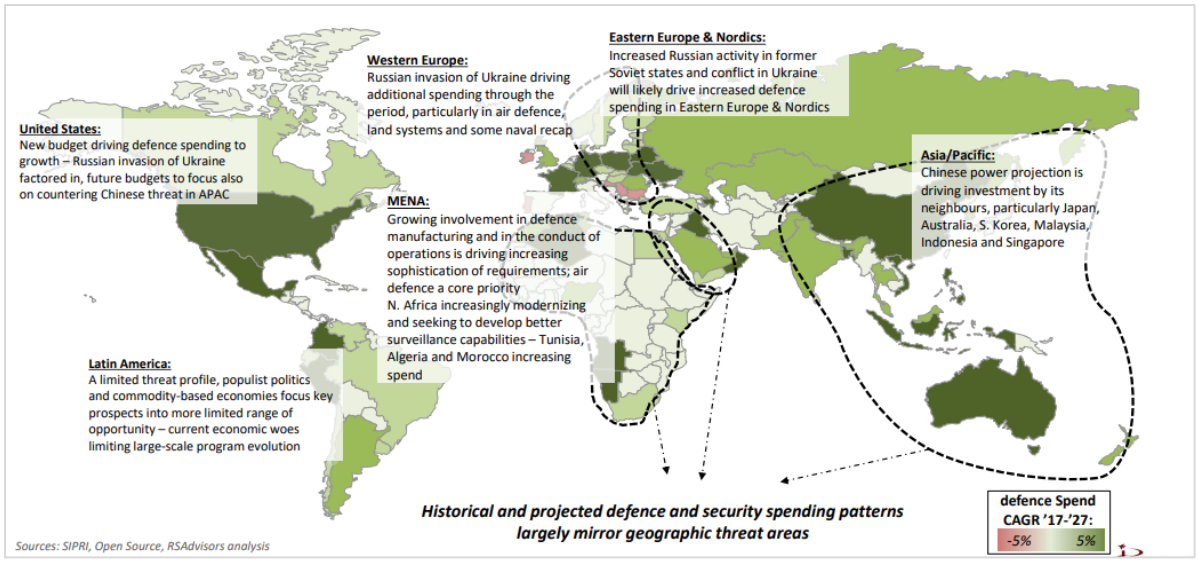

Figure 1: The Global Threat Environment

The resurgence of near-peer adversaries combined with the need to maintain counter-insurgency capabilities means the requirements for modern warfare are likely to be different from either the Cold War period or the initial post-September 11th paradigm. This is causing military planners to revisit existing force structures, concepts of operations and technology investment choices, while still maintaining currency with fundamental doctrines of combined operations requiring integrated use of artillery, main battle tanks, armoured vehicles, air defence, air support and corresponding logistics capabilities. The impact of this dynamic is being seen throughout the spectrum of military capabilities, with governments and armed forces attempting to grapple with new hybrid warfare threats, where the distinguishing line between armed forces, paramilitary forces and civilians is blurred, while also developing new modes of operating across domains in a connected fashion.

The war in Ukraine demonstrates the renewed operational relevance of conventional land forces as the primary means of defending and regaining territory. The war has underscored the emergence of a new form of high-intensity warfare that combines modern technologies with industrial-scale rates of consumption in manpower and materiel. While traditional Concepts of Operation (CONOPS) focused on combined arms warfare remain as valid as ever, they are adapting to modern advances in ubiquitous Intelligence, Surveillance, Target Acquisition, Reconnaissance ("ISTAR") and precision-strike capabilities.

These changes to global security and warfare are also occurring at a time where traditional multi-lateral approaches to global security are eroding. While many international organisations like the North Atlantic Treaty Organization ("NATO") and the European Union ("EU") have found renewed purpose since the Russian invasion of Ukraine, threats linger from adversary nations and non-liberal democracies attempting to sow discord as a means of manipulating decision-making processes and outcomes.

This is resulting in a breakdown in existing treaty structures which have helped to maintain global security and stability, allowing bilateral and regional tensions to grow. Recent examples of this include

growing tensions between the G7[3] and BRICS[4], the breakdown of the Intermediate Range Nuclear Force ("INF") treaty between the United States ("US") and Russia, as well as challenges to international norms in maritime navigation and space operations. These changes to the geopolitical status quo all have a negative impact on the global security picture and reduce the ability of governments to work together to solve existing issues and lower tensions across the globe.

The war in Ukraine has reshaped global alliances. The war has strengthened the traditional 'Western' alliances, where Europe has joined the United States in providing significant military aid to Ukraine. Finland and Sweden have joined NATO, while America's alliances in Asia continue to grow in response to an assertive China. Conversely, Russia and China are building up their own spheres of influence. Both are trying to win over the 'Global South'[5], and the G7's support for Ukraine has underscored the distance in opinion between the rich and developing world on the war. Even if disturbed by the Russian invasion, many developing countries have hesitated to condemn it forcefully and remain more concerned about the impact on food and energy markets.

Russia's invasion of Ukraine is raising tensions between several competing spheres of interest; a Western bloc, the Global South, and a Chinese-Russian alliance of convenience. The impact on defence spending is already being felt. Spending is again being channelled towards conventional threats after nearly two decades of counter-insurgency operations.

The United States is devoting significant investments to the research and development (R&D) of next-generation weapons and platforms. This includes hypersonic missiles, directed energy weapons (DEW), artificial intelligence (AI) and unmanned assets. It is also significantly ramping-up production of precision-guided missiles and munitions, as the war in Ukraine has exposed the immense quantities of munitions needed in a high-intensity conflict.

In Europe, re-equipping armed forced neglected by years of chronic underinvestment is a core priority. Germany has committed a €100Bn special investment fund to modernise its armed forces, especially its armoured and mechanised infantry. Poland is spending heavily on its land forces—buying Main Battle Tanks ("MBT"), Self-Propelled Howitzers ("SPH"), precision missiles from the United States and South Korea—as well as next-generation combat aircraft.

In Asia-Pacific, the growing Sino-American rivalry is prompting regional powers to increase spending. India, Japan, South Korea and Australia are expected to be the central drivers of spending in the region. Among upgrades to its cyber defences and naval platforms, Japan is seeking to acquire long-range "counter-strike" missiles to hit faraway targets in peer adversary nations. Despite ongoing economic cooperation, India is looking to cut back its reliance on Russian equipment and cooperating more closely with the United States. As part of AUKUS, the trilateral security pact between Australia, the United Kingdom, and the United States, Australia and Britain will co-design and build a next-generation nuclear-

[3] Includes Canada, France, Germany, Italy, Japan, United Kingdom, United States
[4] Includes Brazil, Russia, India, China, South Africa
[5] Defined as the collection of countries considered less economically and politically developed, often located in the Southern Hemisphere

powered submarine. They will also cooperate with the United States on the development of long-range missiles.

Characteristics of the Defence Marketplace

Like all markets, defence and security has a set of distinct characteristics and dynamics that govern supplier behaviour, competitiveness and the addressability of demand. As demonstrated by Figure 2 below, defence market dynamics are driven by the interaction of peculiar combination of demand-side customer and supply-side industrial considerations.

Figure 2: Defence Market Dynamics

The defining characteristic of any national defence market is that the government is typically the sole buyer. The fact that there is essentially only one ultimate customer – the Government—drives a series of considerations related to economic return, technology development, security of supply, and for most customers, the requirement to maintain as active a national defence industry supply chain as possible. These factors help create a vast number of policies and behaviours that impact the day-to-day conduct of defence companies. In addition, the complex nature of military operations, and the often-unique operational considerations of individual countries drives those same military/governmental customers to seek bespoke, custom-developed solutions. This creates a further layer of complexity whereby customers often prefer to fund these developments (either in-whole or in-part), and therefore seek out national champions or key providers of capability that be trusted to ensure the security of supply. There are a range of markets where there is a limited national defence industry supply chain and it is here

where most competition exists for exports, normally originating form markets with developed domestic supply chains.

As a result, there are significant barriers to entry into the defence market. End-users may be reluctant to engage new competitive entrants for projects that have long periods of performance and require high levels of technical and project management experience. Most large defence programmes have such complex technology and support requirements that result in development timelines of up to a decade (e.g., Main Ground Combat System – "MGCS"), production periods of a decade or more (e.g., French and Italian FREMM frigate) and sustainment and servicing needs that last even longer (e.g., UK Type 23 frigate).

Macro Defence Spending Patterns

The 'peace dividend' enjoyed since the end of the Cold War is giving way to a new era of increased defence spending across much of the world. Fraught geopolitics – from Russia's invasion of Ukraine to China's assertiveness over Taiwan – are the primary drivers behind sustained spending hikes. Overall, global defence spending is forecast to surpass €2 trillion by 2026 with a compound annual growth rate of 5.2% (see figure 3).

Following decades of underinvestment in defence, **European** defence budgets are witnessing a significant spending uplift in response to the Ukraine war. Europe's total spending is estimated to reach €429bn by 2027, bolstered by a Compound Annual Growth Rate ("CAGR") of 5.4%. Russia's invasion has given Europe renewed energy and purpose. In 2022, Germany pledged a €100bn debt-funded special fund for the modernisation of the country's armed forces and a renewed commitment to NATO's 2% GDP target; Germany, UK, France account for c. 60% of all European defence spending currently. Britain plans to increase spending to 2.5% of GDP by 2030 while France will increase its budget by ~30% over the 2024-2030 timeframe. Central and eastern European countries, feeling more threatened by Russia, are ramping-up budgets at faster pace. Poland aims to spend 4% of its GDP on defence by the end of 2023. The number of NATO countries reaching the 2% target rose from three in 2014 to seven in 2022. At the Vilnius Summit in July 2023, NATO agreed that this target should be "a floor, not a ceiling".

Importantly, the Ukraine conflict has demonstrated the need to upgrade the quality and quantity of Europe's conventional fighting capabilities following two decades of counter-insurgency and the large donations of Soviet-era equipment to Ukraine by former Warsaw Pact members.

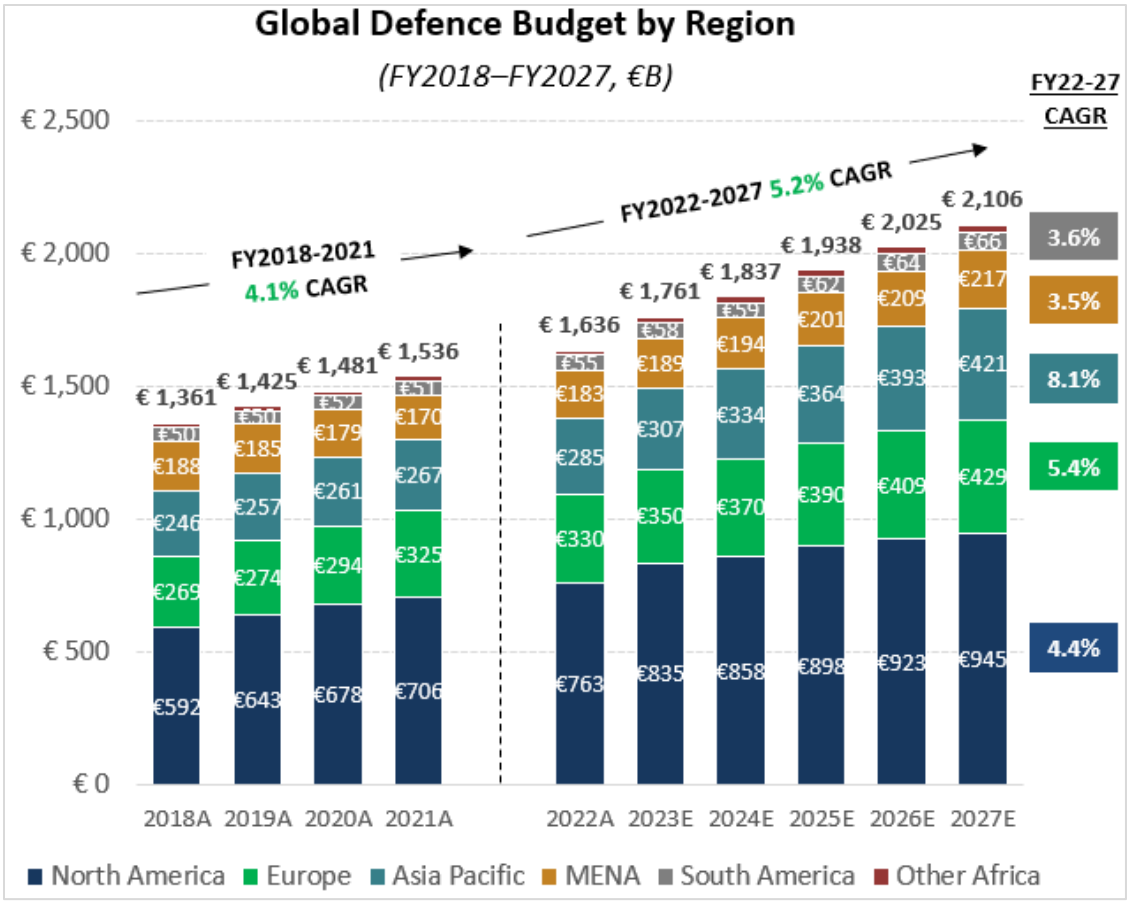

Figure 3: Global[6] Defence Spending by Country (FY2018-FY27, €Bn)

Defence spending in **Asia-Pacific** is being driven by intensifying political tensions surrounding China's assertiveness over Taiwan and the region more broadly. China's defence budget has grown significantly over the past decade, pushing states like India, Japan and the Republic of Korea (RoK) and Australia to modernise their defence capabilities. Japan plans to raise defence spending by two-thirds through to 2027, potentially turning it into the world's third-largest spender. Under the AUKUS deal, America and Britain will help supply Australia with nuclear-powered submarines and long-range strike capabilities to counter China. Defence spending in Asia-Pacific is estimated to grow the fastest of all the regions over the 22-27 period, hitting a CAGR of 8.1% for a total of €421bn by 2027.

Spending is likely to remain high in the **Middle East**, where tensions between the Gulf monarchies and Iran, and low-intensity conflicts in Syria, Yemen and Libya, continue to pose a threat. In Saudi Arabia and the UAE there is a growing focus on the development of the domestic defence industrial base to support military operations as a means of reducing their reliance on foreign companies and partners. However, following a decade of rapid modernization, defence spending growth is forecast to remain steady at 3.5% CAGR and for a total spend of €217bn by 2027.

[6] Excluding embargoed countries Russia, China, DPRK, Afghanistan, Belarus, Central African Republic, Democratic Republic of the Congo, Iran, Libya, Myanmar, Syria, Venezuela, Yemen, Zimbabwe

North America will remain the world's largest defence spender; in 2021, defence accounted for 3% of US Gross Domestic Product ("GDP"). The United States is devoting growing sums to research and development of future weapons as well as replenishing equipment stocks donated to Ukraine. The former includes significant investments in hypersonic missiles, directed energy weapons and artificial intelligence and robotics in order to meet China's growing technological capability. Meanwhile, the war in Ukraine has exposed the very large quantities of munitions needed in a conflict and the inability of peacetime production to meet this demand. As a result, the United States is looking to sustain an elevated level of spending over the next decade to ensure long-term orders of equipment. Spending in North America will remain strong with a 4.4% CAGR with spending nearing ~€900bn by 2027. North American spending is expected to contribute ~46% to global defence spending over 2018-27.

Impact on Military Procurement

The war in Ukraine is likely to have an important impact on spending and procurement decisions over the next five years. Most military customers (including NATO) organize their national spend into several categories, or "accounts" that group money to a related use cases or applications. Procurement includes spending on new equipment and spares. Operations and Maintenance ("O&M") involves spending on training, maintaining, and operating armed forces along with the upkeep of its infrastructure/equipment. Procurement and O&M will be prioritised given the need to upgrade fleets hollowed out by years of underinvestment and the need to retool armed forces with new capabilities. Global O&M spending is forecast to reach €715bn by 2027 with a CAGR of 4.6% while Procurement will hit €412bn at a CAGR of 5.4% (see figure 4).

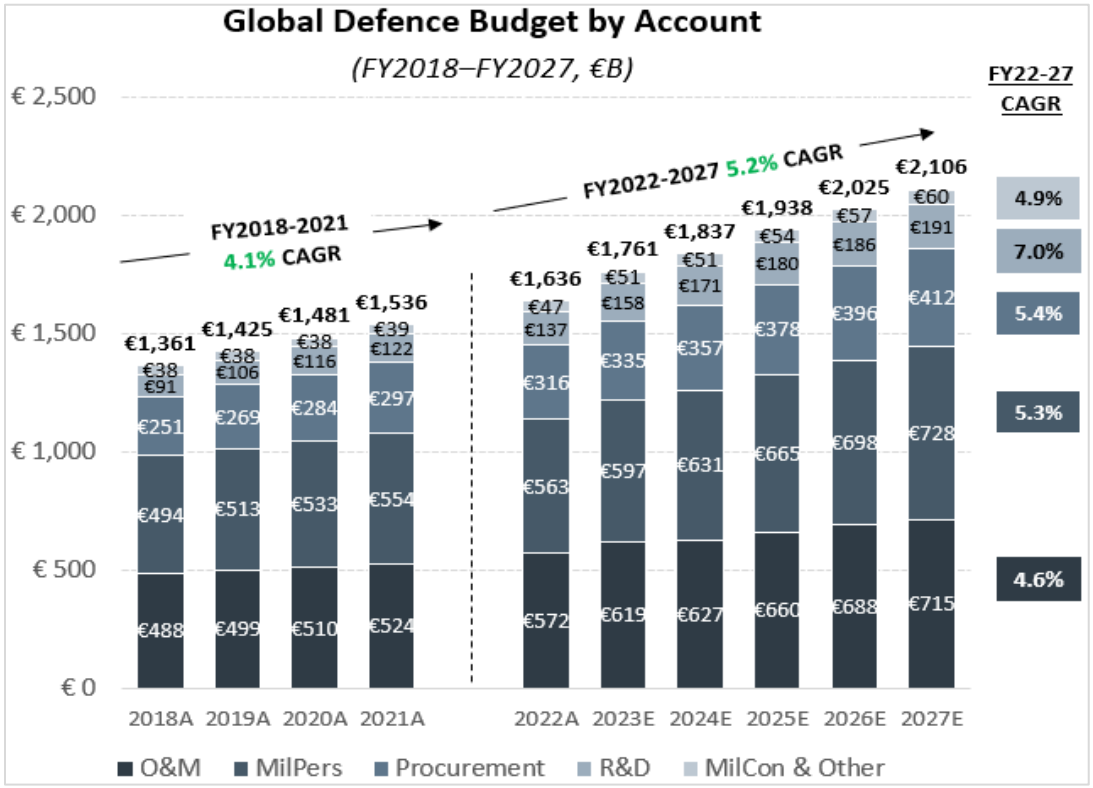

Figure 4: Global Defence Budget by Account

In Europe and the United States, **land systems** are poised to benefit from increased spending on Procurement and O&M. The war in Ukraine has highlighted the importance of land-based combined arms warfare, especially the effective coordination between mechanised infantry, artillery, and protected firepower like MBTs. Upticks in the budget expected to flow through to new vehicle programmes to upgrade and procure new systems. The renewed importance of 'massed' capabilities to withstand the dictates of high-intensity and attritional warfare is also likely to drive longer-term orders. In addition, the United States and various European governments have donated a significant portion of their land vehicle stocks to Ukraine since February 2022 which is likely to prompt a significant recapitalisation and replenishment of land vehicle fleets.

Naval systems are most likely to witness the impact of increased spending in the United States and Asia-Pacific. Over the past decade China has invested in its Navy to spearhead any effort to take Taiwan and project power globally. The US Navy retains its official goal of fielding 355 ships by 2035 to keep pace with China. Sizeable parts of rising defence budgets in Japan, South Korea and Australia will be spent on the procurement of new naval systems to counter China's growing assertiveness in the Pacific.

Land Segment Market Context

Armoured Vehicle Market Trends

Four areas are shaping the market for armoured vehicles:

I. Long-Term Force Realignment
II. The Impact of the Ukraine War
III. Fleet Recapitalisation
IV. Changing Platform Architectures

Long-Term Force Realignment – Wheeled and Tracked

Since the end of the Cold War, the continued relevance of military tracked and wheeled vehicles has been the subject of considerable debate. The demise of the Soviet Union in 1991 was felt to have lifted the forty-year threat posed by the massive armoured and mechanised forces. With the lifting of this threat, Western military thinkers moved from the requirement to maintain large, static and very expensive heavy armoured forces to light and medium weight forces which could be deployed at relatively short notice to potential international conflict zones and were more affordable in the new era of leaner military budgets.

Peacekeeping and counter-insurgency missions post-1989 shifted requirements more towards wheeled armoured vehicles that could be deployed globally, in urban environments, and at short-notice. Wheeled armoured vehicles performed better in close-quarter, urban environment fighting, given better on-road mobility, savings in maintenance, and reduced crew and squad fatigue. Wheeled platforms proved particularly useful during peacekeeping missions like in Kosovo (1999), where users benefited from greater operational sanctuary and lesser need for robust, tracked platforms. Indeed, tracked treads cause more damage to fields and road systems and their limited ability to navigate urban terrain led to additional casualties in these early post-Cold War peacekeeping missions.

The era of Counter-Insurgency ("COIN") operations from 2001 to 2014 in Afghanistan and Iraq demonstrated the need to maintain a mixed fleet of wheeled and tracked platforms. Wheeled platforms initially proved heavily vulnerable to insurgent Improvised Explosive Devices ("IED") and ambushes, especially without effective infantry-fire support. Some missions saw tracked Infantry Fighting Vehicles ("IFVs") and some Main Battle Tanks ("MBTs") deployed alongside wheeled platforms as a means of providing better protection, continuing even after the widespread adoption of wheeled Mine Resistant Ambush Protected ("MRAP") vehicles. Furthermore, unavailability of paved surfaces in those conflicts often rendered tracked vehicles more manoeuvrable. As seen in the Ukraine conflict, use of roads has been minimal as they are under constant surveillance, prompting users to rely most heavily on their tracked fleet of vehicles.

Since 2014, defence planners have increasingly focused on the potential for a near-peer or peer conflict with Russia and China, with scenarios placing greater emphasis on tracked armoured vehicles. From a mobility perspective, tracked vehicles offer several advantages for a platform that is required to operate over diverse terrain, including extremely difficult ground. As the war in Ukraine has shown, a land conflict against Russia would likely involve fighting over muddy and boggy terrain. Hardened roads are

likely to be targets for precision-strike weapons, forcing armoured formations off-road. The terrain in Eastern Europe is particularly prone to silt and mud. While a peer conflict with China would likely to take place at sea, there is potential for a conflict in Asia-Pacific to metastasize into a land battle more regionally. A renewed conflict on the North-South Korean border would likely be characterised by intense artillery battles. Tensions on the austere Indian-Chinese border has seen each side deploy formations of tracked armoured vehicles.

Over the past decade, NATO forces have deployed heavily armoured tracked vehicles to NATO's eastern flank as part of its Enhanced Forward Presence ("EFP") to deter Russia. However, following two decades of COIN missions in the Middle East and depressed budgets, the tracked vehicle capability of many NATO and NATO adjacent states has significantly atrophied. As a result, even before Russia's invasion of Ukraine, many Western militaries had begun to recapitalise and restructure their forces around heavy tracked armoured vehicles suited to the needs of high-intensity conflict. Core MBT platforms like the Leopard 2, Challenger 2 and Leclerc are undergoing important upgrade works, while R&D is underway on the Franco-German MGCS. Additionally, states have been looking to enhance and sustain their tracked IFV and artillery fleets. Germany, for instance, is looking to recapitalise its Puma IFVs and PzH2000 SPHs following decades of underinvestment in maintenance. However, what became clear as a result of the Ukraine war is that current equipment levels within most NATO members have proven themselves to be inadequate to effectively conduct and survive a similar engagement within another near peer.

Vehicle fleets among NATO+ states will continue to use tracked and wheeled platforms in tandem, driving steady demand for both over the next decade. Given the renewed focus on peer-conflict, and the relative lack of investment over the past decade compared to wheeled platforms, the market for tracked vehicles is likely to grow faster than wheeled vehicles. However, wheeled vehicles will remain important for land forces seeking a balanced fleet of platforms, with the view that fighting in such a peer conflict will likely take place over varied terrain that is conducive to operation of both types.

Impact of the Ukraine War

The land-based nature of the war in Ukraine has been a lesson in old-style attritional conflict; reemphasising the importance of large, massed armoured formations and manoeuvrers. Fighting in Ukraine since February 2022 demonstrates that armies on the attack still need ways of moving their troops forward, protecting those soldiers as they advance and, most importantly, packing enough firepower to push through defences. Tracked MBTs and other armoured vehicles that combine these three capabilities have been essential to both Ukrainian and Russian CONOPS over the past 18 months.

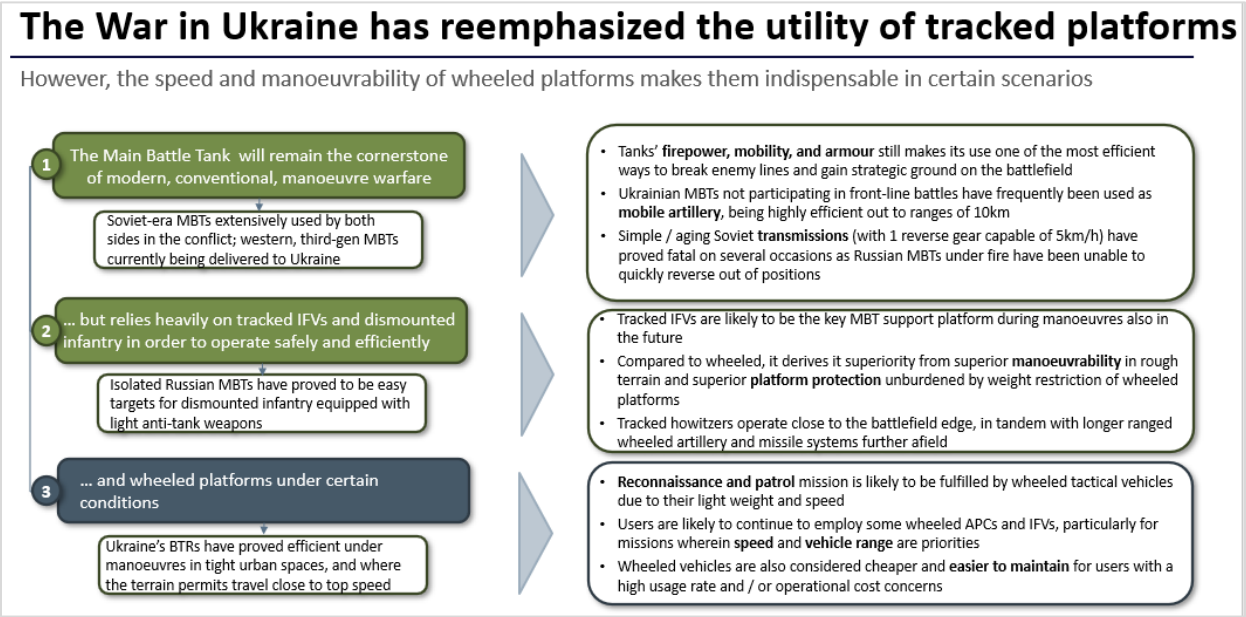

Figure 5: Utility of Tracked Platforms

Initially the war in Ukraine seemed to confirm criticisms of tracked armoured vehicles. Russia suffered significant losses to its Armoured Personnel Carriers ("APCs"), Armoured Fighting Vehicles ("AFVs") and MBTs during the opening invasion. Small Ukrainian units wielding Anti-Tank Guided Munitions ("ATGMs") and armed Uncrewed Aerial Vehicles ("UAVs") proved a potent threat to Russian armoured units. However, many experts have assigned these losses to Russia's poor implementation of combined arms warfare tactics that require the seamless integration of armour, infantry, and artillery platforms. In the opening months of the war, Russian armoured units advanced with air defence or dismounted fire support.

As Europe's biggest land war since 1945, land systems have proven critical in sustaining both sides. Vehicle-mounted indirect fires have formed the mainstay of operations, whether artillery or rocket-launched systems. Given the breadth of platform transfers, Ukraine has employed a mix of wheeled and tracked platforms. Tracked and wheeled Self-Propelled Howitzers have been vital in pinning down enemy forces to stop them moving, or to destroy them, often to allow infantry and armoured vehicles to advance. Ukraine has used American-supplied High-Mobility Artillery Rocket Systems ("HIMARS") and Multiple Launch Rocket Systems ("MLRS") systems to devasting effect on Russian arms dumps and command posts, while remaining survivable to return fire given the ability to 'shoot and scoot' quickly.

The war has also demonstrated the importance of tracked platforms as a way of operating over boggy and uncertain terrain. Russia has targeted Ukrainian roads, pushing many of its armoured vehicles to use off-road routes. Tracked IFVs have proven essential in shuttling troops over difficult and open terrain.

Fleet Recapitalisation Programmes

The United States and Europe have donated significant portions of their armoured vehicle fleets to Ukraine. These range from MBTs like the Leopard 2, Challenger 2, and M1 Abrams to tracked IFVs like the Marder and M2 Bradley. A range of tracked and wheeled artillery systems have also been donated to Ukraine, including the PzH 2000, CAESAR, M109, AS-90, and MLRS. The scale of these transfers to Ukraine is generating an acute need to replenish fleets and replace aging platforms. Former Warsaw Pact states have donated the majority of their Soviet-era armoured fleets to Ukraine, speeding up the need for new platform acquisitions.

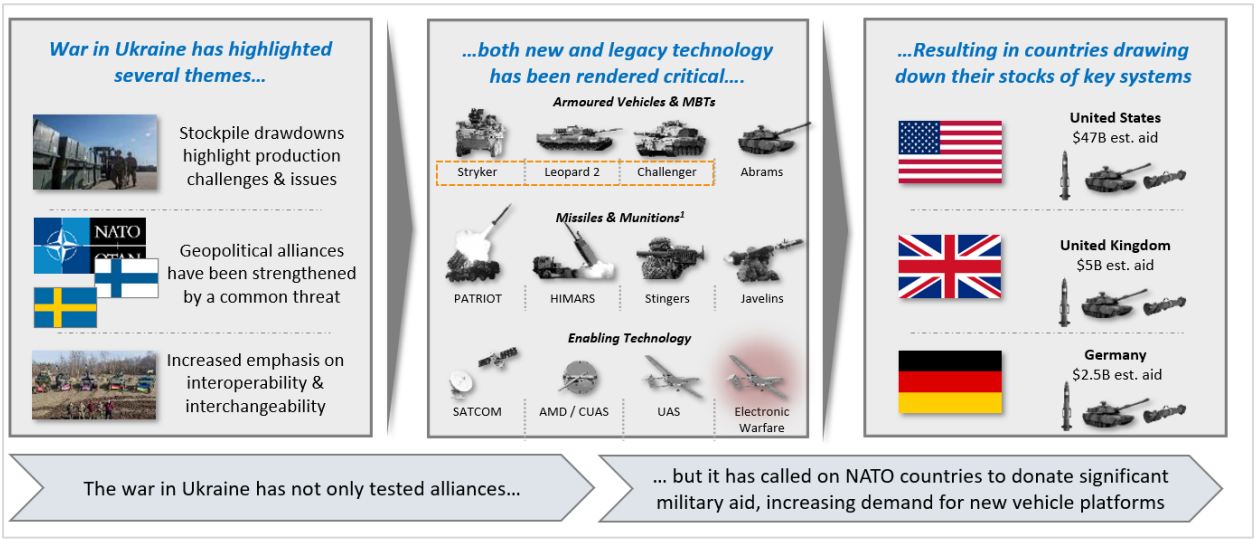

Figure 6: NATO Platform Drawdown & Restocking

In the United States, the 'Presidential Drawdown Authority for Military Assistance' guarantees federal funding to replace or refit platforms donated to Ukraine is likely to revive demand in North America. As of August 2023, the President's Office has authorized 32 drawdowns in assistance to Ukraine. Many of these drawdowns have involved the transfer of munitions and armoured vehicles, such as 155mm artillery rounds and M2 Bradley IFVs. In invoking the Drawdown Authority, the President authorises funding for the Pentagon to replace those items with new procurement. Donated platforms like the M1 Abrams MBT, M113 APC, M2 Bradley IFV and Stryker 8x8 are most likely to benefit from drawdown replacements.

Figure 7: Presidential Drawdown Authority[7]

Moreover, defence budget lifts are likely to benefit armoured fleet recapitalisation programmes in the near to medium term. These include developmental programmes like the Optionally Manned Fighting Vehicle ("OMFV") programme in the United States – now known as the XM30 Mechanized Infantry Combat Vehicle - and the Franco-German MGCS in Europe.

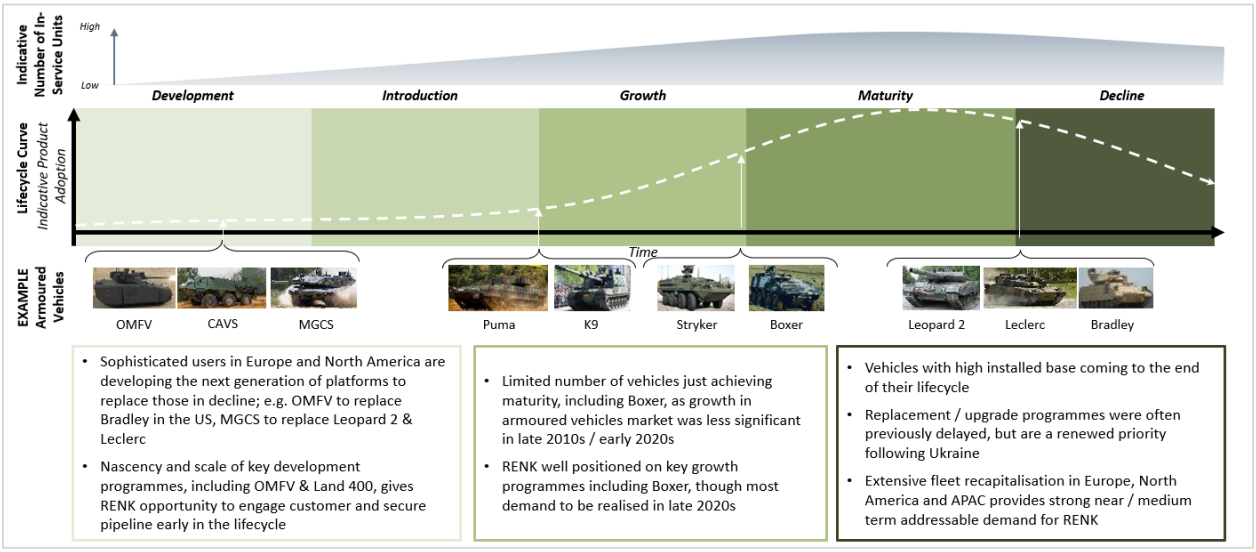

Figure 8: Fleet Recapitalisation

Per Figure 8 above, some long-standing armoured vehicle programmes are also nearing maturity, like Boxer. In the near-term, some states are opting to buy ready-made, off-the-shelf solutions to rapidly close capability gaps amplified by donations to Ukraine. Poland, for instance, has procured extensive quantities of armoured vehicles from South Korea including the K2 Main Battle Tank and K9 Self-Propelled Howitzer. Similar off-the-shelf programmes include Britain's Mobile Fires Platform ("MFP") programme and Australia's Land 400 that are also seeking to procure existing vehicle platforms. This

[7] Congressional Research Service (CRS), Government Accountability Office (GAO)

trend is likely to continue throughout the rest of the 2020s, particularly as Eastern European customers seek new platforms for their donated equipment, and the relatively low scale of armoured vehicle production pushes deliveries well into the 2030s.

Armoured Vehicle Technology Trends

Emerging technology enablers are increasingly shaping the armoured vehicle market. Four areas in particular are shaping the next generation of armoured vehicles:

I. Digitisation
II. Increased Autonomy
III. Advanced Protection and Weapons Systems
IV. Sustainable Propulsion

Digitisation

Ground forces are pursuing the digitisation of their military platforms for a range of operational and technological reasons. The proliferation of affordable sensors and precision-strike systems increasingly requires digitally enabled time-sharing and analysis of data to shorten 'sensor-shooter' loops. Digitisation allows quicker and more efficient communication between command posts and units in the field and enables greater data interoperability between disparate platforms. As militaries look to increasingly connect every sensor to every shooter, the digitisation of a platform's underlying architecture will be key. This will be key within the broader operational concepts being developed in the 2020s under the banner of Multi-Domain Operations ("MDO") or Joint All Domain Command and Control ("JADC2"), whereby the need to connect and operate in concert with vehicles, aircraft and potentially even naval platforms is coordinated using a series of resilient networks at the tactical and strategic level. In practice, this means that armoured vehicles (both wheeled and tracked) will be increasingly called on to host electronic and digital systems to help generate and operate these connecting networks.

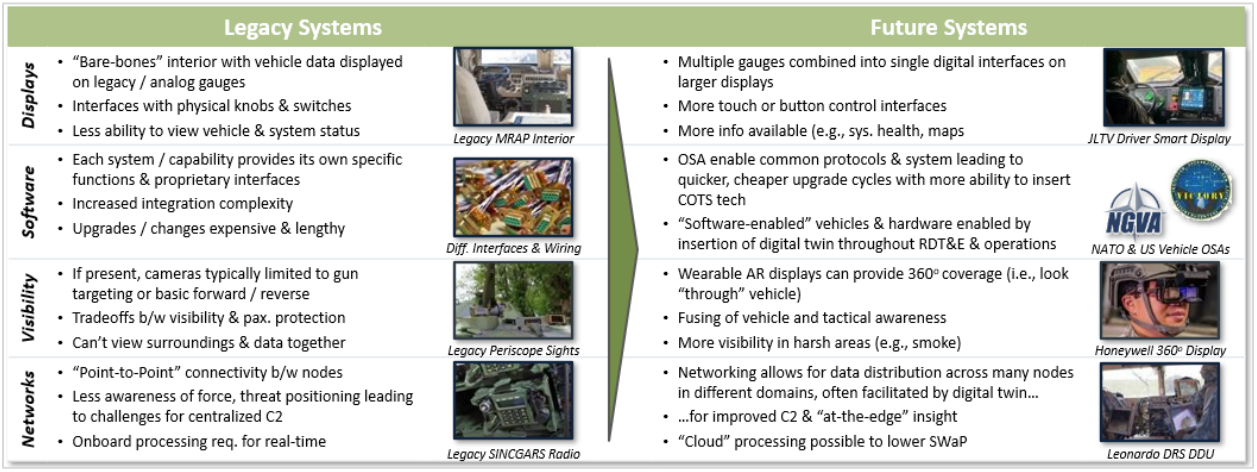

Figure 9: Land Vehicle Digitisation

The digitisation of armoured vehicles also involves integrating advanced digital technologies to enhance their capabilities, situational awareness, communication, and overall effectiveness on the modern battlefield. This transformation leverages a range of technologies including sensors, communication systems, computing power, and software applications to create “smart” armoured vehicles that can operate more efficiently and collaboratively. Where legacy armoured vehicles used to contain a handful of digital assets, future platforms will be defined by them.

Artificial intelligence (“AI”) is a key contributor to digitisation. The proliferation of on-board sensors and data collection abilities of each vehicle will require advanced algorithms to sift through vast datasets to streamline and ease the strain on human decision-making.

This sort of digitisation is most pronounced in the ‘virtualisation’ of armoured vehicles interiors. In processing vast troves of incoming data into a common operating picture, AI algorithms are radically improving vehicles’ situational awareness. Currently, armoured vehicle display suites remain overwhelmingly analogue; relying on physical gauges, knobs and switches that are vulnerable to wear and tear. Multiple gauges and information inputs diminish the ability to operators to get a snapshot view of the whole vehicle and system status. By contrast, future systems are likely to combine multiple gauges into a single digital interface, powered by AI. Digital interfaces could also be connected to on-board cameras as a means of providing enhanced visibility for human operators. Currently, vehicle cameras are typically limited to gun targeting and basic forward/reserve functionality. The fitting of small, AI-powered optical sights could provide users with 360-degree coverage with real-time video feed overlaid with critical data.

However, legacy vehicle protocols and software makes the digitisation of platforms challenging. Open System Architectures (“OSA”) will be central in underpinning the move towards digitisation. OSAs refers to the design and implementation of systems, software, and hardware using open and standardized interfaces, protocols, and components. Indeed, data transferability will be key to future military operations as militaries look to connect ‘every sensor with every shooter’. Currently, platforms with different protocols and data standards cannot ‘talk’ to each other. By emphasising the use of standardised interfaces, communication protocols, and data formats, components from a different vendor or platforms can effectively function as part of a larger system. As technology evolves, OSAs can accommodate new components and functionalities without requiring significant changes to the existing system. This scalability is vital for long-term adaptability and avoiding ‘vendor-lock’.

Digitisation will impact vehicle Original Equipment Manufacturers (“OEMs”) and their supply chains in multiple ways. OSA requirements for more ‘fused’ on-board electronics will require ever more power generation from vehicles. Suspensions and other structural components will become more critical as built-in sensors communicate with the rest of the platform’s electronic suite and provide timely and useable data feedback to operator interfaces as well as providing better power generation.

The development of digital twins will also accelerate the digitisation of armoured platforms. A digital twin is a virtual representation of a physical object, process or system. Real-time data can be inputted to generate simulations that can predict performance and anticipate future upgrade or maintenance needs.

Digital twins will increasingly be used by end-users and for armoured vehicles to enhance their design, development, testing, operation, and maintenance processes in a cost-effective manner.

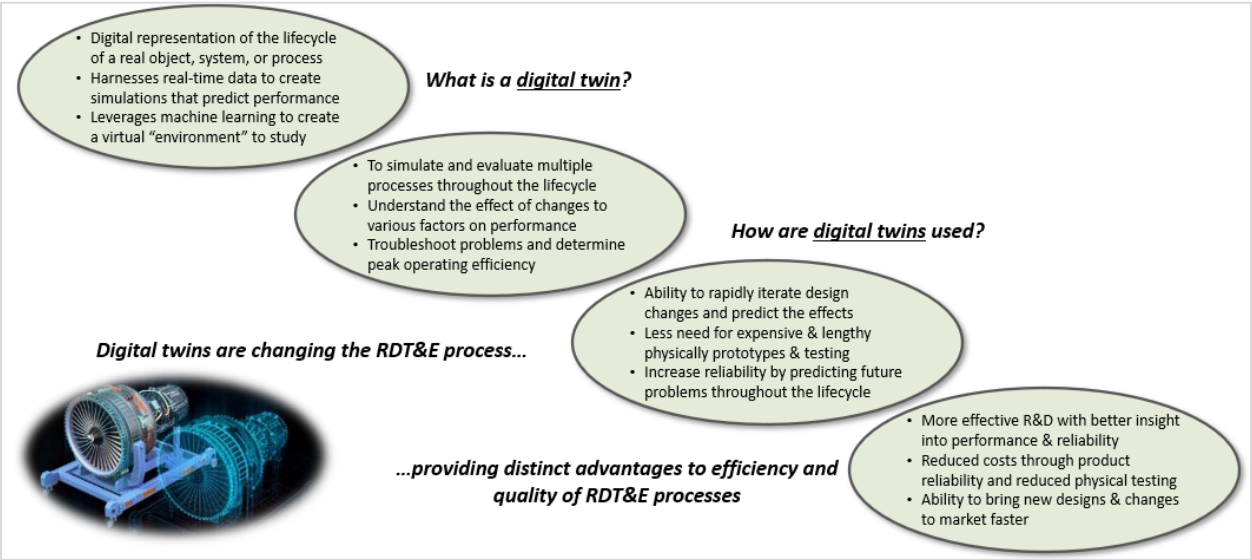

Figure 10: Digital Twin Development and Definition

Digital twins allow designers to create virtual prototypes of armoured vehicles, enabling them to test and iterate different designs before physically building the vehicle. Moreover, engineers can simulate various operating conditions and scenarios, such as off-road terrain performance, to identify areas of potential weakness.

In the long run, digital twins are likely to provide cost and time savings as RENK looks to develop or improve products before bringing them to market.

Increased Autonomy

The next generation of armoured vehicles are also likely to feature autonomous capabilities. Where sixth-generation aircraft are likely to become 'motherships' for unmanned assets, armoured vehicles could for example become hubs for autonomous ground vehicles that can scout ahead and perform other tasks in a distributed battlespace. In the United States, the XM30 is being designed precisely with such an autonomous capability in mind.

The next generation of armoured vehicles will have increased autonomy…	…enabling several key battlespace advantages..	…though development of autonomous land system requires several technological enablers
 *Optionally Manned Fighting Vehicle (OMFV)*	***Advanced Sensors & Cameras*** • Precise measurements of position, orientation, speed, etc. will require more sensors for effective autonomy • Optical technology is critical for awareness & pathfinding and must be effective in limited visibility (e.g., LiDAR)	**Access to Harsh Environments** • Precise measurements of position, orientation, speed, etc. will require more sensors for effective autonomy • Optical technology is critical for awareness & pathfinding and must be effective in limited visibility (e.g., LiDAR)
	Increased Processing Capability • More computing power needed to process data from many sensors at high update rates for constant self-awareness plus algorithms / software that fuse data from many sources	***Additional Protection*** • Additional sensors and real-time data processing, combined with next-generation armour, offer increased platform and force protection • Lower number of manned assets
 *Robotic Combat Vehicle – Light (RCV-L)*	***Secure & Reliable Networking*** • Constant comms and data sharing is required with other vehicles, systems, and/or remote operators for C2 of AVs • Networks must be reliable in remote locations & secure	***Reduction in Operators*** • AVs may leverage remote operators, "follow" manned vehicles in a manned-unmanned teaming arrangement, or operate entirely on their own

Figure 11: Future of Autonomous Systems

Per Figure 11 above, uncrewed ground vehicles ("UGVs") can generate a range of operational advantages over purely manned systems. For instance, UGVs equipped with advanced sensors and bolstered by real-time processing capabilities could provide enhanced situational awareness on the battlefield. By acting as expendable Intelligence, Surveillance and Reconnaissance ("ISR") tools to relay targeting information to command posts, UGVs could form an integral part of the 'kill chain'. Building on their historical deployments as explosive ordnance disposal platforms, UGVs can access harsh environments without putting human operators at risk. Moreover, by reducing the need for human operators, UGVs could also help bolster 'mass' and act as force multipliers for land forces. UGVs can assist advancing armies by carrying heavy loads, providing logistical support and perform repetitive tasks.

The development of autonomous land systems will require the development of several key technological enablers. Additionally, at a more basic level, the creation of UGV capabilities should provide Original Equipment Manufacturers ("OEM") and supply chain providers with additional, higher volume, market potential around transmissions, engines and suspension systems for these smaller and more disposable platforms.

Autonomous navigation and obstacle detection and avoidance systems will require reams of on-board sensors and cameras for UGVs to perceive their surroundings and terrain. The aggregation of additional sensors, processing power and networking equipment will demand significantly more electrical power generation from each individual system. UGVs will also need to operate for extended periods of time in the field without recharging or refuelling, placing emphasis on power optimisation solutions.

UGVs will be required to adapt to diverse and challenging terrains – from arid deserts and rugged mountains to urban environments. This places a premium on developing systems that can adapt to varying terrain and surface conditions, requiring the continued development of rugged suspension and propulsion solutions.

Maintaining reliable communications between UGVs and human operators is also a crucial challenge. Ensuring communication resilience in environments with signals interference, electronic warfare for jamming will prove a challenge, though the growth of digitalization of the battlefield and the advent of MDO and JADC2 capabilities should provide UGVs with resilient, scalable network communications capabilities that allow them to interface with other platforms and systems beyond their own operators.

Advanced Protection and Weapons Systems

As discussed previously, Artificial intelligence is a key factor underpinning next-generation armoured vehicles, especially as it involves weapon and protective systems. The idea of collecting data from sensors, processing them with algorithms fuelled by ever-more processing power and acting on the output more quickly than the enemy lies at the heart of modern military CONOPS. However, placing these emerging capabilities on armoured vehicles will require considerably more power to operate as well as robust vehicle frames which can account for the added weight of new systems.

The emergence of AI-based targeting and Active Protection Systems ("APS") are likely to require increased power generation for the additional processing, sensor-data fusion, and autonomous decision-making involved. Future APS could require the 'auto-positioning' of each vehicle; requiring they take control or communicate with propulsion and other mechanical systems on the vehicle.

Moreover, the proliferation of precision-strike systems means APS systems are being retrofitted on a variety of legacy platforms, such as Stryker, M2 Bradley and M1 Abrams in the United States. However, the added weight can complicate already limited SWaP constraints on legacy platforms. Despite their lower logistical footprint, the emergence of directed-energy weapons ("DEWs") requires significant power generation and cooling capability. As these APS become increasingly common, increasing demand will be placed on suspension, propulsion and vehicle frames to support this added weight.

Lastly, the emergence of advanced armour materials is also impacting vehicle SWaP considerations. The growth of capabilities that can detect signals beyond the visual spectrum – such as heat or electronic signatures – is pushing the development of new 'multispectral' deception solutions. Many of these aim to reduce a vehicle's heat and electronic emissions through netting or infrared camouflage. As a result, greater emphasis could be placed on propulsion and suspension manufacturers to explore advanced materials to save weight, as well as provide quieter and heat-reduced propulsion to lower vehicle signature emissions.

Sustainable Propulsion

Hybrid or electric propulsion systems are being considered for armoured vehicles as a way to address various challenges related to efficiency, sustainability and operational capabilities. Today most vehicles rely on fossil fuels for propulsion and electric power generation. US and NATO planners optimised many vehicles to run off jet fuel to maximise supply chain and logistical efficiency. However, transporting and protecting fuel supplies is becoming an increasing source of vulnerability to enemy long-range strike capabilities. As such, R&D efforts into the development of hybrid-electric systems and more efficient electric generators is becoming a priority.

Indeed, hybrid-electric systems will be in focus over the near term. Beyond their logistical benefits, hybrid systems provide tangible operational advantages. Given that armoured vehicles need to operate over long distances and in challenging terrains, hybrid solutions can improve fuel efficiency by allowing the vehicle to operate in low-power electric mode. The instant torque conferred by electric engines can be beneficial for off-road capabilities and rapid acceleration when quick manoeuvres are required. Moreover, electric propulsion allows armoured vehicles to operate quietly, reducing their acoustic and thermal signature. This could be of particular use in reconnaissance, surveillance, and special operations missions where stealth is crucial. Moreover, the growth in UGV use over time would likely benefit from development of hybrid-electric systems, potentially increasing range and lowering noise and thermal emissions for these smaller platforms.

Ultimately, however, it is likely that a mix of energy sources will be used to fuel armoured vehicles of the future. Hybrid systems require additional components like batteries, electric motors, and a range of power electronics. These early components remain bulky, and can therefore add weight to the vehicle, reducing space for other payloads. Limited electric ranges could also limit the operational utility of some electric vehicles, especially during extended missions. It is likely that smaller, robotic tactical vehicles will be the first to fully electrify given their lower power consumption and operational relevance.

Armoured Vehicle Market Size and Growth Patterns

Land Market Forecast & Sizing: TOTAL Market

The total armoured vehicle market is growing at 8.4% over the 2022-27 period. Much of the growth is being driven by the European market, which is growing at 15.4% over 2022-27. Higher European growth can in large part attributed to re-investment in larger fleets of tracked armoured vehicles, as well as the overhaul and refurbishment of existing platforms. These include costly programmes, such as upgrades to Leopard 2, Challenger 2 and Leclerc MBTs. Urgency has been added to re-investing significant funds into its armoured vehicle fleets following the lessons from the Ukraine war. Growth in Asia-Pacific is primarily driven by the sustainment procurement of artillery systems and MBTs, such as the K2 in South Korea. This spending will grow steadily over the forecast period at 5.9% (2022-2027).

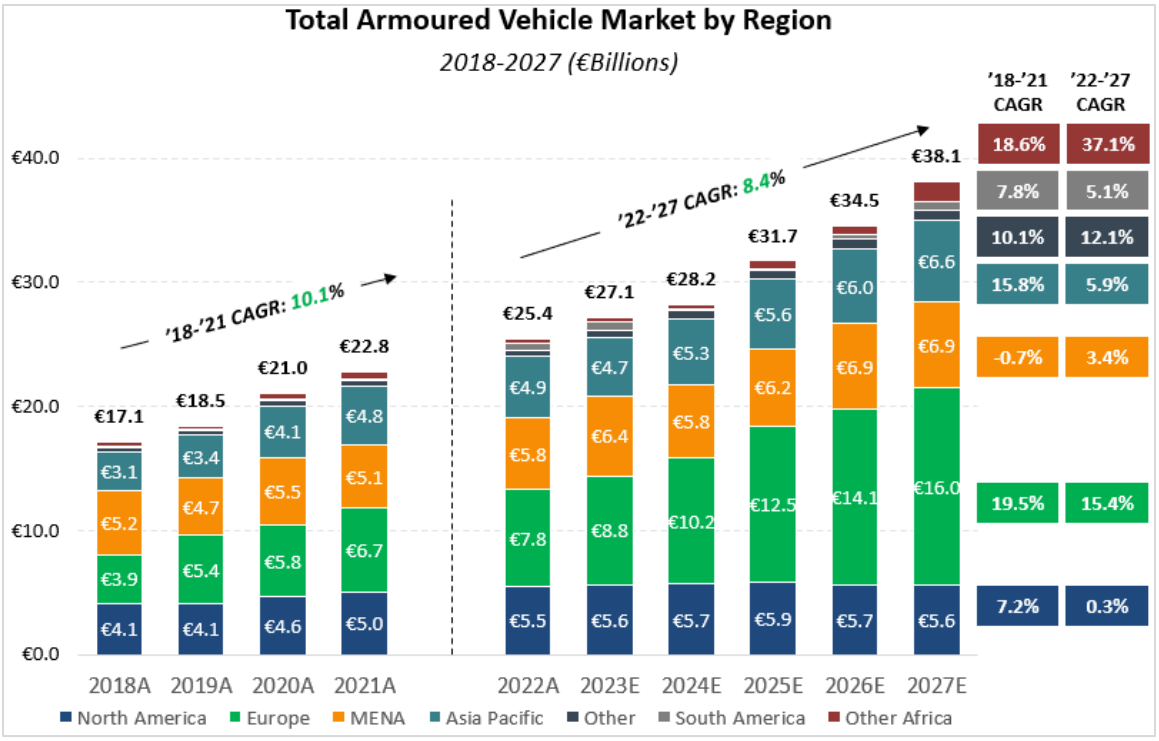

Figure 12: Total Armoured Vehicle Market by Region

Among armoured vehicles, tracked platforms will see stronger growth over the 2022-27 forecast period at 12.6%. Much of this is being driven by the overhaul and recapitalisation of MBT fleets following decades of underinvestment and large donations to Ukraine since 2022. Tracked artillery systems are likely to witness a similar trend as European states look to replace their depleted stock with new build platforms. Wheeled vehicles will grow at a steady 2.3% over the forecast period, mostly sustained by retrofitting and recapitalisation of 8x8 and 6x6 platforms for peer-style conflicts. Some wheeled artillery systems, like the French-made CAESAR, are also likely to see more spending over the forecast period. However, wheeled platforms grew faster (7.5%) in the 2018-21 period given programmes like Boxer and the sustainment of lower cost 4x4s used during COIN operations.

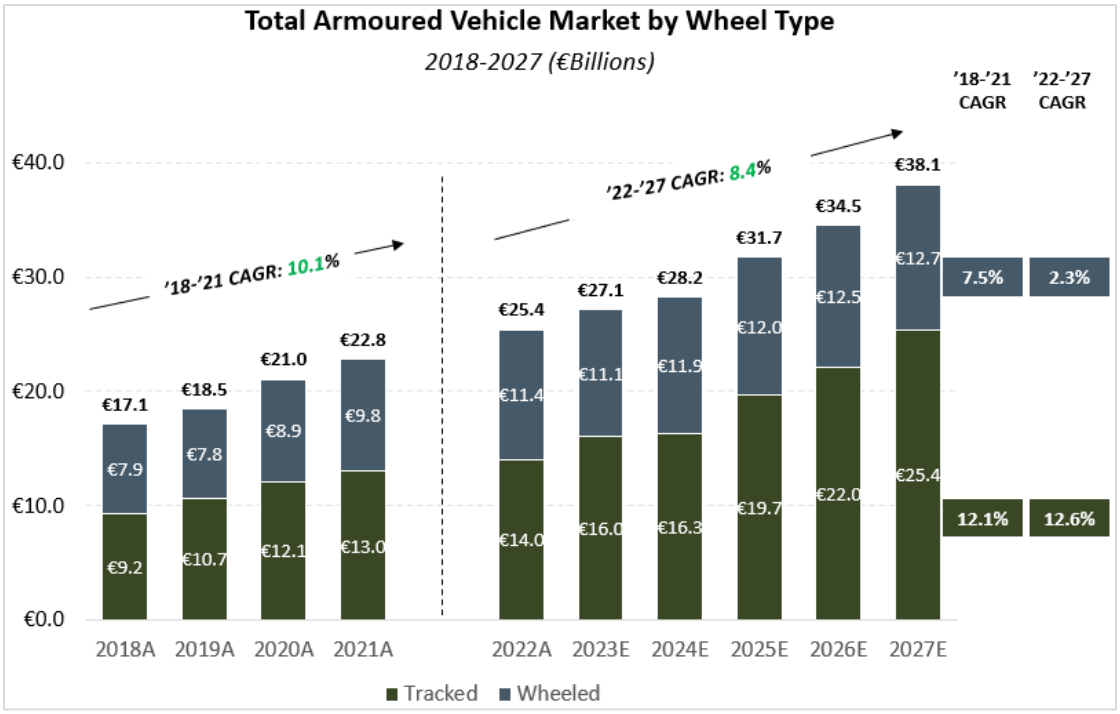

Figure 13: Total Armoured Vehicle Market by Wheel Type

Naval Segment Market Context

Military Naval Market Trends

Four primary trends are affecting the military naval market:

I. The Resurgence of the Naval Domain
II. Russian and Chinese Naval Assertiveness
III. Changing Maritime CONOPS
IV. Changing Platform Architectures

Resurgence of the Maritime Domain

In both Europe and the Pacific, naval warfare is once again growing in importance. The intensifying rivalry between the United States and China in the Indo-Pacific is pushing regional states to retool their navies, while Russian submarine activity in the North Atlantic remains a persistent threat to European security despite Moscow's strained military since invading Ukraine in 2022.

In the first instance, Russian and Chinese navies pose a pressing threat to the international maritime order. The importance of open sea lanes as conduits for trade in goods and energy supplies has long been recognised; 80% of global trade by weight and volume is still transported by sea.[8] Free-flowing

[8] https://unctad.org/publication/review-maritime-transport-2021#:~:text=Over%2080%25%20of%20the%20volume,report%2C%20published%20annually%20since%201968.

maritime trade relies on a rules-based international system to which almost all states subscribe for their own benefit, but which only the United States, in partnership with its allies, has had the means to police.

Increasingly, China has posed a challenge to the American-led global maritime commons. In the western Pacific, China has behaved provocatively towards American allies and tested the bounds of international maritime law. Most emphatically, China claims maritime sovereignty over the 'Nine-Dash Line'; a U-shaped route that stretches over 700 nautical miles from China's coastline, encircling most of the South China Sea that plays an outsize role in global trade and security. China is also seeking to patrol the choke points that give access to the Indian Ocean, through which most of its energy imports flow.

Taiwan is also at the centre of China's naval concerns. China's People's Liberation Army Navy ("PLAN") continues to develop not only the means to recover what it sees as a renegade province, but also defeat Taiwan's main protector, the United States. As an island, it would provide China with access to the Pacific and underwater depths suitable to operate with submarines as a Chinese submarine port. China has invested significantly in its long-range strike arsenal to disrupt, paralyse, or destroy critical operational and logistical nodes underpinning American naval strength known as "Systems Destruction"[9] (See figure 14).

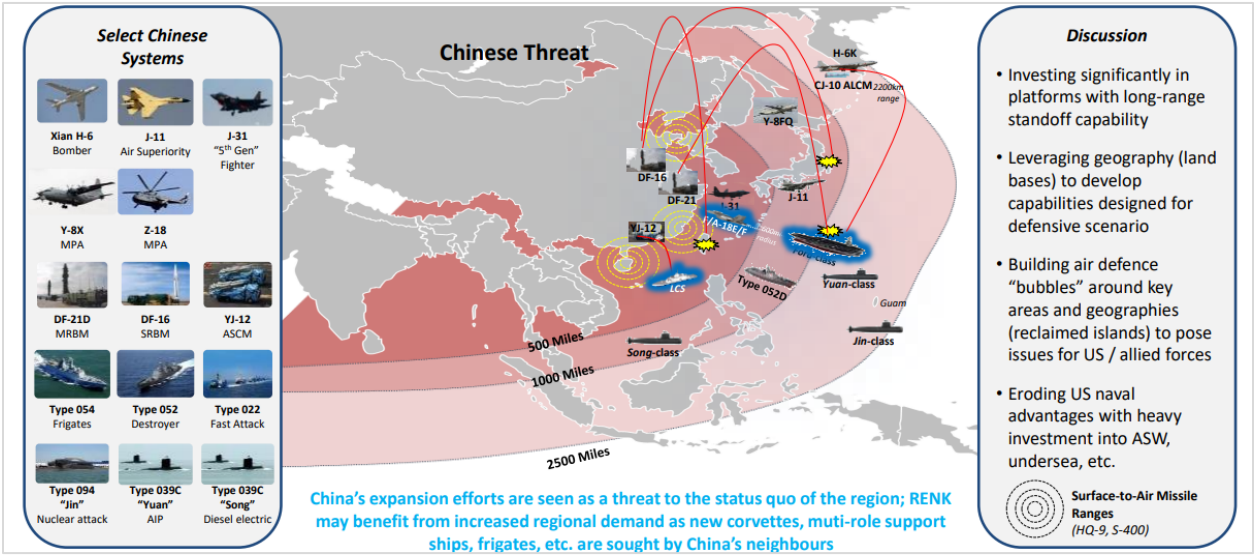

Figure 14: Chinese Military CONOPS

China's ground, sea, and air-launched platforms can increasingly strike American naval assets at operational depth. China's H-6K bomber, for instance, has a range of 3,000 km and its YJ-12 cruise missiles another 400 km. the CJ-20 land-attack cruise missile an extra 1,500 km. The DF-21 boats a range of 2,150 km and the anti-ship variant of the DF-26 4,000 km. The DF-26's range also places the strategic island of Guam, and its key American military facilities, within striking range.

[9] https://www.rand.org/pubs/research_reports/RR1708.html

The PLAN has grown over the past two decades into a largely modern, home-made naval force capable of projecting power abroad.[10] The PLAN surpassed America's as the world's largest navy in 2020 and is now the centrepiece of a fighting force that the Pentagon considers its "pacing challenge".[11] The PLAN has about 340 "battle force" vessels, including carriers, submarines, frigates and destroyers (see figure 7). That number is likely to reach 400 by 2025 and 440 by 2030, according to the Pentagon.[12] Among the new ships will be about a dozen larger amphibious ships. Though US Navy vessels retain greater capability, China is rapidly modernising. According to the Pentagon, its fleet is already "largely composed of modern multi-role platforms featuring advanced anti-ship, anti-air, and anti-submarine weapons and sensors".[13]

In response, the United States is weaving together a series of regional multilateral defence initiatives to hem China in. Its focus remains on bolstering defences and its alliances among 'first island chain' countries: a series of islands stretching from Malaysia to Japan. America is looking to deploy advanced land-based air defence systems in Korea, Japan and the Philippines as well as on its own naval assets to blunt China's arsenal of missiles. In response to Chinese hawkishness, Japan is upending its pacifist postwar constitution to acquire long-range "counter-strike" weapons capable of hitting targets in mainland China. Japan and South Korea continue to investment in long-endurance, stealth attack submarines, with Japan in particular, releasing a request for its largest ever defence budget.[14]

In the second island chain, stretching as far as Guam, the United States is looking to bolster its long-range strike capabilities and enhance the survivability of its naval and air assets. The United States Navy is looking to expand to 355 ships.[15] This will partly be achieved by the development and deployment of more unmanned naval assets. This aims to complement new CONOPS that emphasise the importance of 'distributed operations', the art of spreading out more widely to complicate enemy targeting and survive incoming missiles.

The Russian Naval Threat

In the North Atlantic and Arctic region, the Russian navy continues to pose a threat to maritime security and trade. Russia has been imposing rules on ships that wish to transit the Northern Sea Route (NSR), an Arctic passage between the Atlantic and Pacific that is becoming increasingly navigable as global warming melts icesheets. Moreover, Russia has bolstered its Northern Fleet in recent years with new ships and attack submarines. In the North Atlantic, Russian submarine activity is as its highest level since the Cold War. Russian submarines like the *Yasen* and *Borei*-class are quieter than previous generations,

[10] https://www.rand.org/pubs/research_reports/RR1708.html
[11] https://www.defense.gov/News/News-Stories/Article/Article/2845661/china-remains-pacing-challenge-for-us-pentagon-press-secretary-says/
[12] https://uk.finance.yahoo.com/news/china-capacity-build-pla-combat-053331757.html
[13] https://news.usni.org/2022/11/29/pentagon-chinese-navy-to-expand-to-400-ships-by-2025-growth-focused-on-surface-combatants
[14] https://www.reuters.com/business/aerospace-defense/japan-makes-record-defence-spending-request-amid-tension-with-china-2023-08-31/#:~:text=TOKYO%2C%20Aug%2031%20(Reuters),trillion%20yen%20over%20five%20years.
[15] https://www.navytimes.com/news/your-navy/2021/05/10/to-reach-355-ships-navy-must-revamp-shipbuilding-recruitment-and-retention-advocacy-group-says/

reducing NATO's ability to detect submarines at longer range, and carry advanced weapons like the *Kalibr* cruise missile (see figure 15).

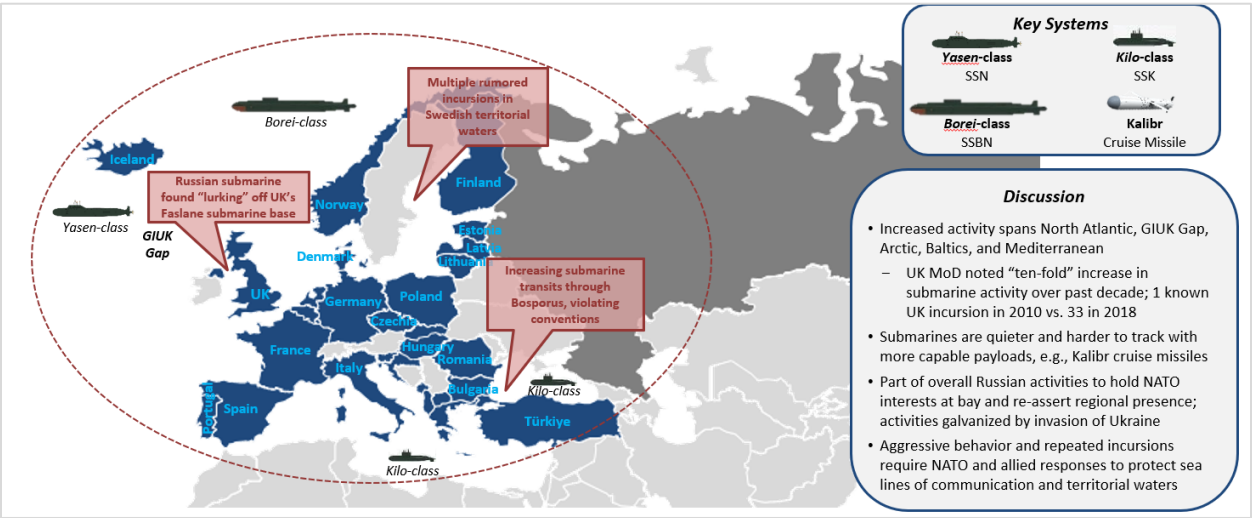

Figure 15: Russia's Submarine Threat

Increased Russian submarine activity has also been associated with undersea cable and energy infrastructure sabotage. Such infrastructure is increasingly seen as a potent target for adversaries looking to coerce neighbouring economies. Officials note that Russian underwater activity in the vicinity of undersea cables has surged in the past decade. Moreover, in Europe pipelines are vital conduits for energy. Some, like the two Nord Stream connectors, bring gas from Russia; others take oil and gas from the North Sea ashore in Britain, the Netherlands and Norway. The sabotage of undersea energy pipelines Nord Stream 1 and 2 confirmed the vitality of undersea infrastructure, and the threat undersea military assets could pose.

Increased Russian naval activity since the mid-2010s is leading to a corresponding ramp-up in European naval procurement. France is moving ahead with the procurement of a new *Frégate de Defence et d'Intervention* ("FDI") intermediate-size frigate shipbuilding programme. Germany is also revamping its Navy with investment in a new F126 frigate programme and beginning conceptual analysis for an F127 successor. The F126 will provide the Germany Navy with mission modularity to accomplish a range of varying operational requirements.

Both France and Germany represent a broader European trend to focus on modular, multi-mission ships. In 2019, Permanent Structured Cooperation ("PESCO") and the European Council agreed to the Modular and Multirole Patrol Corvette ("MMPC"). Italy, France, Greece, Spain, Denmark, Norway and Romania have signed on to the project. Modularity provides more operational flexibility to respond to different mission sets without having to invest in multiple, specialised vessels. Multi-mission modular ships can reduce costs by sharing common components, systems, and infrastructure.

Changing Naval CONOPS

Given the threat posed by China and Russia, navies in Europe and Asia are retooling. Users are adapting to the challenges of peer conflict at sea following nearly two decades focused on counter-piracy and

counter-terror support missions. This marks a departure from the 1990s and early 2000s, where the lack of an identifiable peer competitor had dramatic knock-on effects on fleet size and capability.

Absent the Soviet Union, the 1990s witnessed a shift towards smaller fleets, bolstered by agile and deployable force structures. In the United States, carrier strike groups remained the centrepiece of power projection and were deployed more frequently given their newfound operational freedom. This included carrier-based strike missions in Bosnia, Afghanistan and Iraq. The 1990s also marked the transition and growing reliance of Western navies on technological force multipliers like Command, Control, Computers, Communications & Intelligence ("C4I") or precision effects to ensure adversary overmatch.[16]

By the early 2000s, counter-insurgency missions in Afghanistan and Iraq and counter-piracy missions in the Horn of Africa, privileged the deployment of naval assets in near-shore environments. Stemming the threat of terrorism and narcotics smuggling drove the growth of CONOPS focused on littoral operations. Cold War-era cruisers and destroyers designed for open-ocean warfare proved ill-suited for operations in shallow waters, facing threats from roving high-speed missile boats or anti-ship cruise missiles. Programmes like the US' Littoral Combat Ship ("LCS") derived from these changing CONOPS. As demonstrated by the LCS programme, the 2000s also marked a period when ships shifted to multi-mission payloads; emphasising concepts like modularity and flexibility to reduce both the time and cost of modernizing in-service ships and to adapt to future uncertainties.[17]

In light of Russian and Chinese modernisation, naval CONOPS are again shifting to peer and open ocean conflict. A range of programmes are underway to develop the next generation of surface and subsurface combatants. The include the Constellation-class and the revival of the Arleigh Burke in the United States, Germany's F126 frigate and the Type 26/31 frigates in the United Kingdom.

Many of these ships are being built as multi-role, adaptable platforms with modular equipment to enable a variety of different mission sets. The increasing commonality of design means achieving greater economies of scale than has traditionally been the case. It is difficult for navies to anticipate exactly what missions its fleet will need to carry out in the future. As missions and technologies change, the typical response is to modernize ships to accommodate the new mission or technology. However, modernization is expensive, and the physical configuration of the ship may limit what can be done. Modularity entails partitioning a system into modules that consist of self-contained elements and can be swapped out depending on new mission requirements.

Shifting Architectures

Major technological trends that will influence naval operations over the coming decade – the proliferation of Uncrewed Surface Vessels ("USVs"), the electromagnetic spectrum as a weapon, long-

[16] https://www.usni.org/technological-superiority-not-panacea#:~:text=The%20U.S.%20Navy's%20strong%20bias,%2C%20amphibious%20ships%2C%20and%20submarines.
[17] https://www.rand.org/content/dam/rand/pubs/research_reports/RR600/RR696/RAND_RR696.pdf

range strike and the increasingly networked nature of the battlespace – will require a concomitant shift in naval platform architectures.

Given the costs of building multi-mission ships, many navies are turning to unmanned assets as a means of bolstering fleet mass. Unmanned assets enable the rapid expansion of naval capability at a fraction of the cost of traditional shipbuilding. Indeed, the added mass conferred by unmanned assets are starting to underpin emerging naval CONOPS. Three main pillars are driving news CONOPS: distributed, ubiquitous and networked operations.

'Distributed' maritime operations involve the wide spreading out of fleets to increase the difficulty of enemy targeting and enable better survivability against potential incoming missile salvos. Uncrewed ships have the advantage of being smaller (and so harder to spot on radar), and cheaper to build and operate. This is to be complemented by their 'ubiquitous' character; large fleets of friendly USVs capable of swarming at a given point. Lastly, these dispersed forces need to be 'networked' together to enable seamless transfer of information and cooperation (see figure 16).

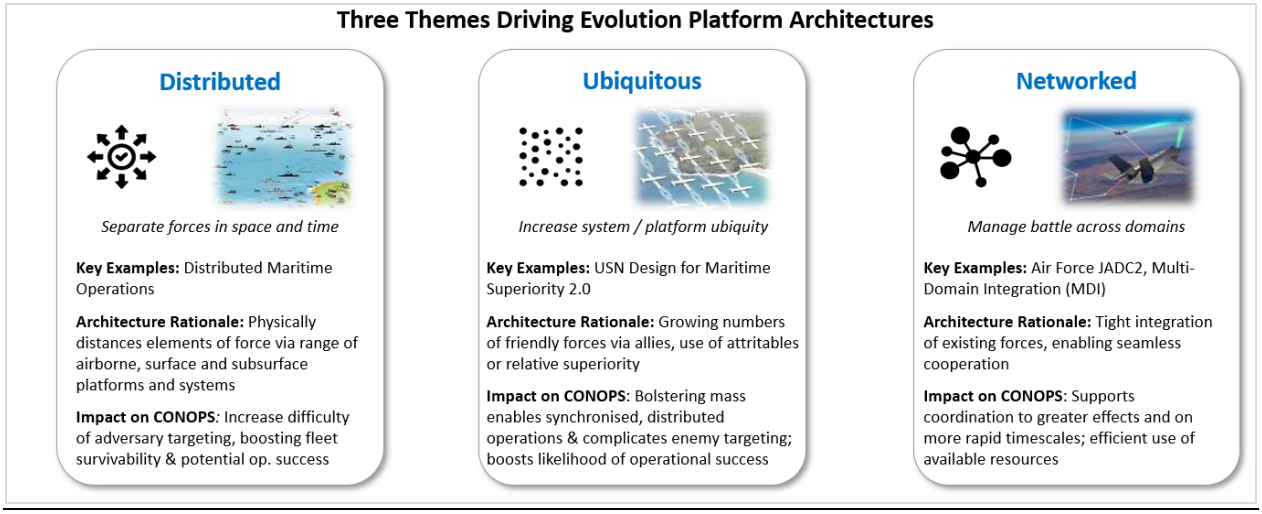

Figure 16: Shifting Platform Architectures and New CONOPS

Ships will require enhanced power, cooling, and bandwidth capabilities to keep pace with emerging CONOPS and technology. The growth of energy-consuming systems like DEW or advanced radar will require greater power-generation. The return of large surface combatants as potential command and control ("C2") and communications nodes demands enhanced networking for integration with unmanned assets, as well as 'sensor-shooter loops' with other air and land-based platforms (see figure 17).

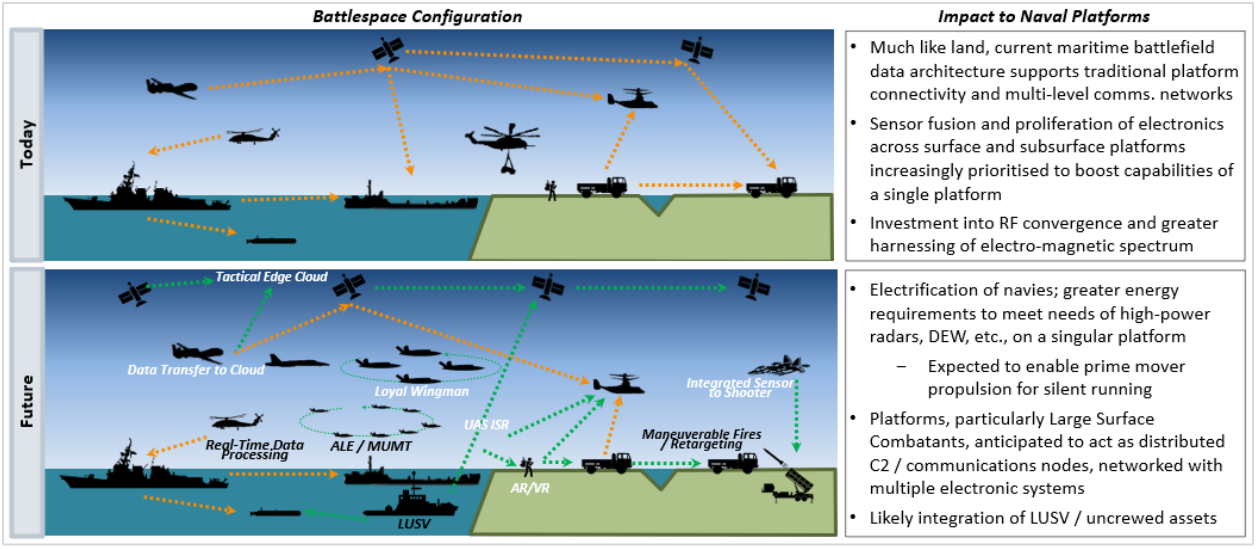

Figure 17: Greater Connectivity Across Vessels

As naval ships become defined by their digital architectures, onboard electronics and sophisticated weapon systems, their power generation needs will increase concomitantly. This will place greater mechanical demands on platforms, especially their propulsion and power generation systems.

Naval Market Technology Trends

i. Electrification of Platforms
ii. Next Generation Effects
iii. Digitisation of Systems & Interfaces
iv. Platform Autonomy

Electrification of Platforms

The electrification of military ships involves the integration and utilization of electric propulsion systems and technologies in naval vessels, with the goal of enhancing operational efficiency, reducing environmental impact, and improving overall performance.

Interest in hybrid and electric propulsion systems for naval ships is growing as concerns increase over climate change, new regulations and rising fuel costs. Yet hybrid propulsion systems also offer logistical and operational advantages over traditional fossil fuels. Where traditional naval propulsion systems use mechanical components like gearboxes, shafts, and propellers, which are powered by diesel engines or gas turbines. Electrification replaces these components with electric motors connected directly to the propellers, reducing the need for complex mechanical systems. This provides greater flexibility in propulsion and allows for improved control and efficiency. A reduced acoustic signature from electric propulsion systems also serves to enhance stealth characteristics.

Current and next-generation ships are facing increased SWaP requirements from the installation of larger and more power-hungry sensor and weapon systems. The shift towards network-centric warfare requires ever more sophisticated sensors, like radar. Active electronically scanned array (“AESA”) radars, for example, offer better detection and tracking capabilities compared to traditional radars. They can

electronically steer their radar beams quickly and precisely, allowing them to scan the surrounding area more rapidly and accurately. Moreover, this allows them to perform multiple functions simultaneously, such as surveillance, tracking, and fire control. This multi-functionality reduces the need for separate radars for different tasks, saving space and reducing equipment complexity on the ship.

Yet as warships are increasingly fitted with complex weapon systems and sensors, they require greater power generation capacity. Indeed, naval vessels require a reliable and efficient power generation system to provide electricity for propulsion, as well as onboard systems and equipment. Next-generation ships and effectors are expected to consume vast amounts of electrical energy; the choice of propulsion systems on new platforms is likely to be influenced by these emerging requirements (see figure 18).

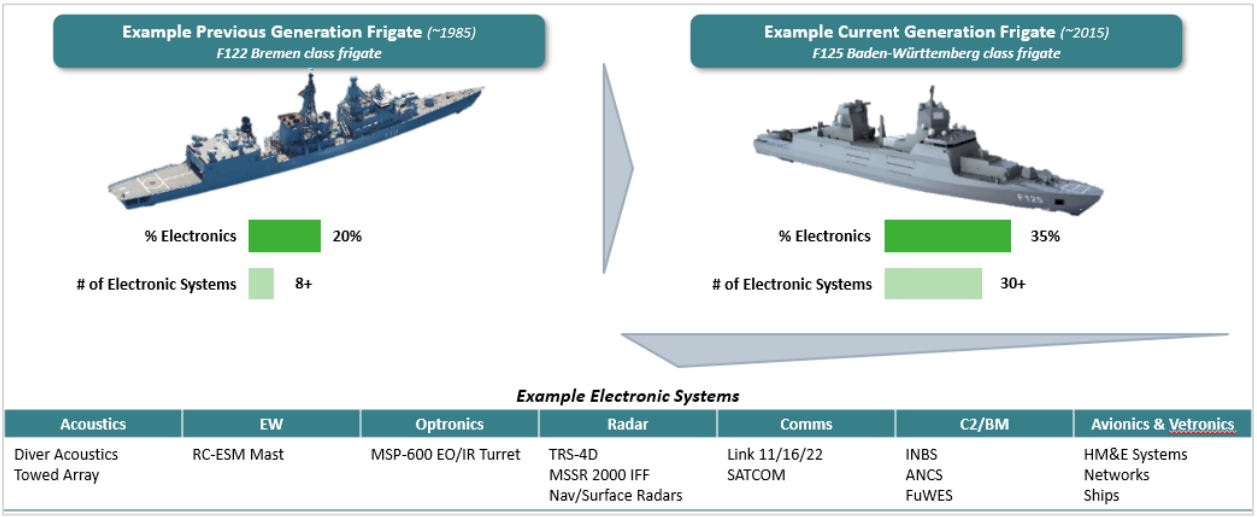

Figure 18: Growing Electronic Suites on Naval Platforms

Next-Generation Effectors

The requirements of next-generation, ship-based weapons systems are placing stringent SWaP demands on new surface combatants. In particular, the introduction of Directed Energy Weapons and hypersonic missiles could impact the mechanical design of platforms and their propulsion requirements (see figure 18)

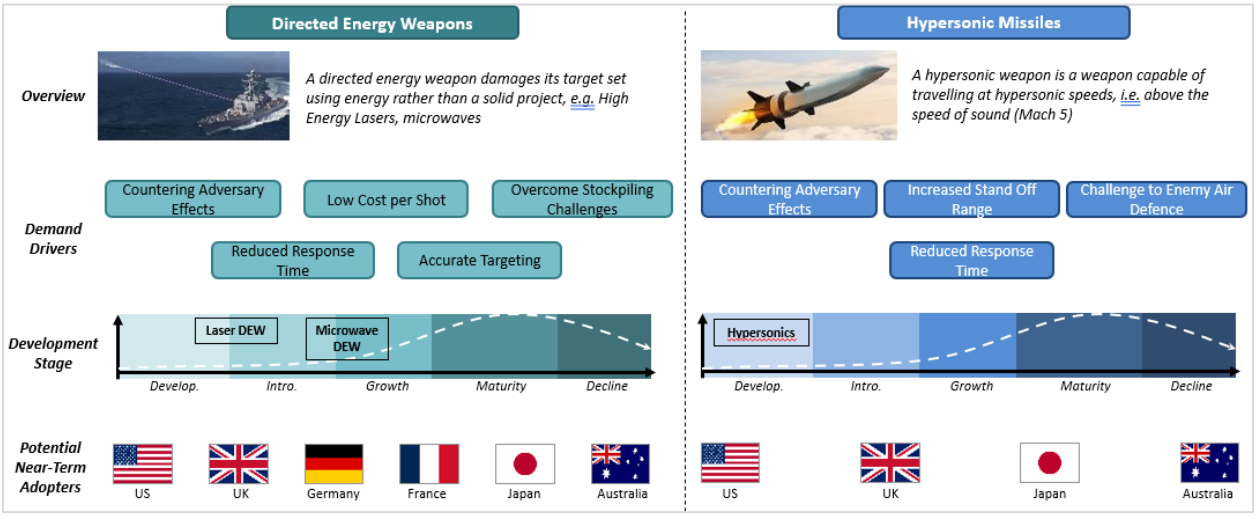

Figure 19: The Impact of Next-Generation Effectors

The installation of DEWs on ships is likely to have the most impact on naval power generation requirements. DEWs offer several advantages that can significantly enhance a naval force's capabilities and effectiveness in modern maritime warfare scenarios. DEWs allow nearly instantaneous engagement of targets, which make them especially important for countering threats like anti-ship missiles, drones, and other fast-moving objects. Moreover, DEWs use electricity as their primary power source, reducing the need for storing and transporting traditional ammunition. This can lead to cost savings over time and a smaller logistical footprint. Yet as a result, DEWs require substantial amounts of electrical power to generate the intense energy needed to operation; ships need to have sufficient power generation and distribution systems to support the demands of DEWs without compromising the energy needs of other key systems.

Likewise, the introduction of hypersonic anti-ship missiles means ships will need to upgrade their missile defence systems. These systems may include advanced interceptors, DEWs, and improved radar and sensor systems capable of tracking and engaging hypersonic targets. As with DEWs, advanced air defence systems like require more power and potential redesigns of naval platforms to accommodate hypersonic and anti-hypersonic technologies. This will impact ship OEMs and supply chain providers given the need to design ships with spaces and power generation solutions that can be reconfigured for new sensors, weapons, and defensive systems as they become available.

Digitisation of Systems and Interfaces and Platform Autonomy

A network-centric naval force, where multiple ships and unmanned platforms are interconnected through advanced communication and information-sharing systems, will have significant implications for power generation requirements on ships and USVs. This will largely stem from the increased need to power various onboard electronics, sensors, comms systems and the data and computational processing tools that connect them.

Like armoured vehicles, different naval assets use diverse communication protocols, data formats, and equipment. Achieving seamless interoperability among these systems will require standardizing communication protocols and ensuring compatibility between legacy and new systems through Open Systems Architectures.

This will not be without challenges. Currently, the transmission of large amounts of data in real-time between ships often can strain bandwidth.[18] As network-centric naval warfare relies on communication networks, data processing, and sensor systems, these technologies require a continuous and substantial power supply. That will only intensify in the future, where motherships will need to communicate with scads of dispersed USVs and surface combatants, placing an emphasis on generating enough power to process the needs of different sensors, C2 systems and autonomous vehicles. With ever more interconnected ships exchanging real-time data, information, and intelligence, there will be a greater demand for electrical power to support the operation of communication systems, sensors, data processing equipment, and other electronic components.

The reliance on complex communication networks and data links can make naval operations highly dependent on uninterrupted connectivity. Building redundancy and backup systems will become crucial in mitigating this risk. Hybrid propulsion systems could offer a means of diversifying and building-up greater redundancy and resilience on naval platforms. Moreover, greater energy storage solutions will also be critical in ensuring uninterrupted operations in case of power failure or outage.

The deployment of unmanned assets will further deepen the need for effective power generation sources aboard naval platforms. Unmanned assets to be deployed in swarms or networks to execute complex coordinated operations will need effective planning of power distribution to maintain communication links and coordination among the unmanned assets and their motherships. Moreover, unmanned assets heavily rely on communication systems to transmit collected data back to other naval assets. Ensuring reliable and secure communication requires robust power sources and management will be essential in underpinning distributed CONOPS.

The increase in autonomous naval systems, while smaller and more rugged than manned systems, will result in increased absolute demand for naval propulsion systems. Given that each unmanned asset is likely to be fitted with a range of electronics such as sensor systems and C2 units, such platforms will require a reliable source of power generation.

[18] https://apps.dtic.mil/sti/tr/pdf/ADA349582.pdf

Naval Market Size and Growth Patterns

Naval Market Forecast & Sizing: TOTAL Market

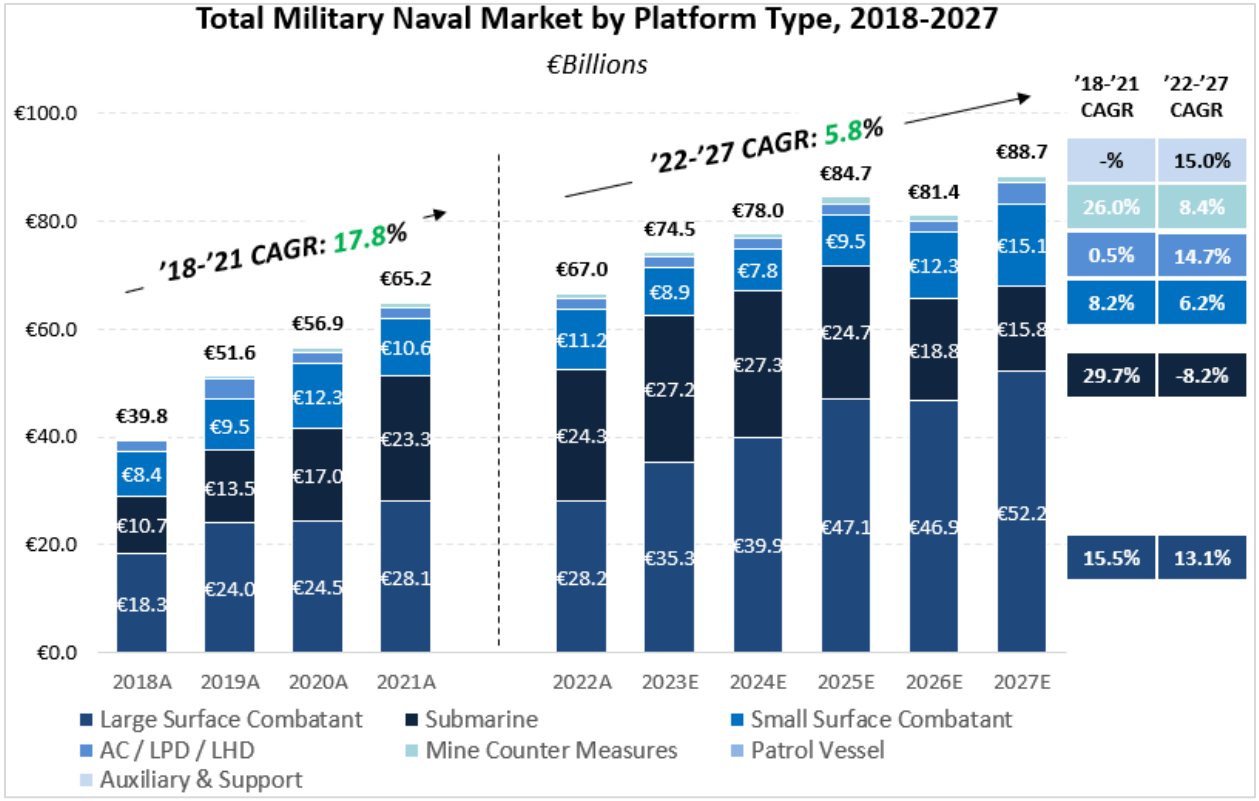

Figure 20: Total Military Naval Market by Platform Type, 2018-2027 (€Bn)

The military naval market has grown at a CAGR of 17.8% over the 2018-21 period and is expected to grow at 5.8% over the 2022-2027 period. Whereas recent growth in the land domain has come largely because of the Ukraine war, the naval domain saw a ramping of programmes in the mid-2010s. These programmes are now starting to mature, such as the Franco-Italian FREMM, and explain the lower rate of growth in the outer forecast period. However, new programmes are expected to begin in the period after 2027, including Britain's Type 83 destroyer, the DDG(x) programme in the United States and the European Patrol Corvette planned to enter service from 2030 onwards.

Large Surface Combatants will account for ~50% of the naval market, reaching €52.2bn in 2027; much of this is driven by major ship building and recapitalisation programmes in the US, Europe and Asia-Pacific regions. Investment into multi-mission vessels like OPVs and corvettes equipped with ASuW strike capabilities are also pushing growth; small surface combatants have a higher number of deliveries, but a

lower value. The use of sea mines in the Russo-Ukrainian war[19] has also brought renewed and sustained attention on Mine Counter Measures ("MCM"), keeping CAGR at 8.4% over the 2022-27 period.

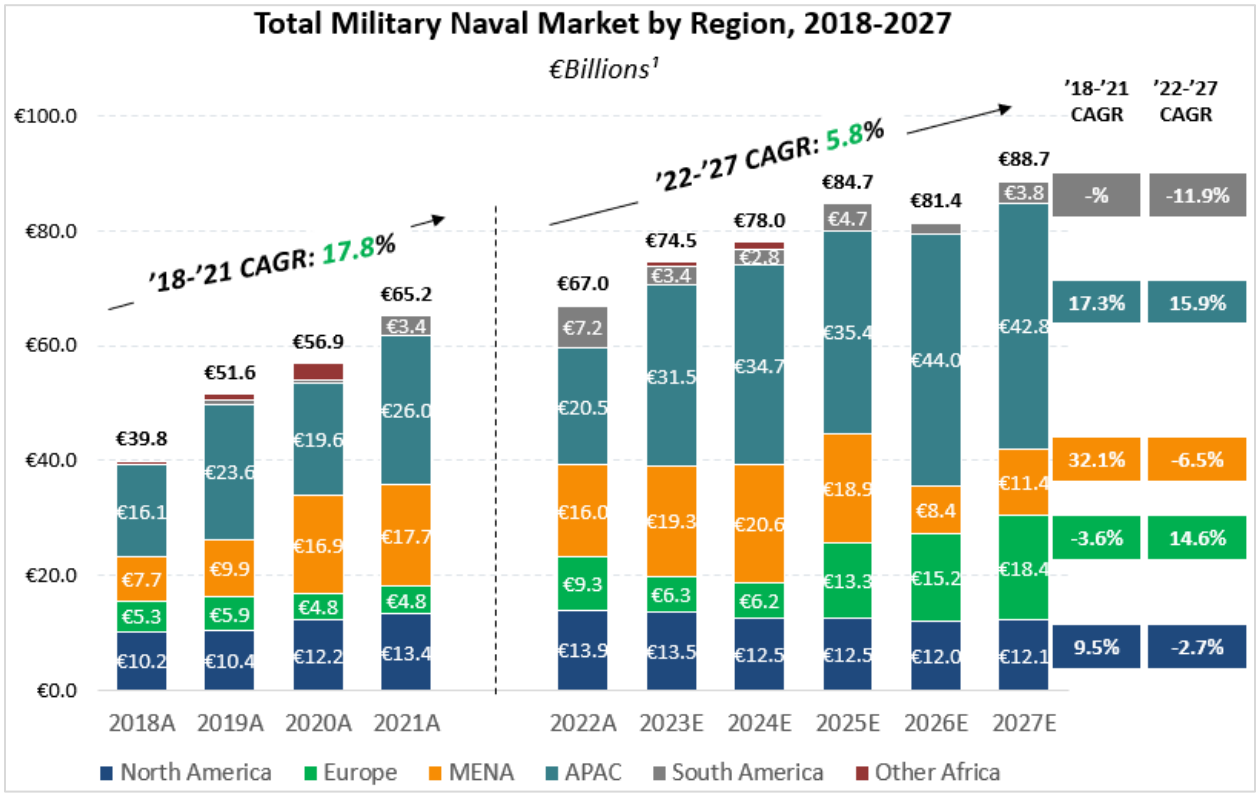

Figure 21: Total Military Naval Market by Region, 2018-2027 (€Bn)

The Asia-Pacific region is the primary driver of investment into naval platforms as regional navies look to respond to the threat posed by China. With a CAGR of 17.3% over 2018-21 and 15.9% in the 2022-27 forecast, spending in Asia-Pacific will stay high over the decade. South Korea, Japan and Australia form the core of this spending, accounting for ~20% of the total between 2022-2027. In South Korea, this investment includes the KSS-III attack submarine and KDX-IIA and FFX-III surface combatants. Japan is investing in its next-generation Taigei-class submarines and the continued procurement of Mogami-class surface combatants. The Hunter, Hobart and Arafura-class in addition to AUKUS are driving investment in Australia.

European investment by contrast remains lumpier, characterised by ad-hoc investments. Europe declined -3.6% CAGR over the 2018-21 period but grows significantly over the 2023-2027 forecast period at 14.6% as programme begin to ramp. Large programmes include the F126 Frigate in Germany as well as joint European ventures like the FREMM and common corvette programmes. The United Kingdom is also investing significantly by introducing three new classes of vessels (Type 26 frigates, Type 31 frigates and Fleet Solid Support ships). In the United States, the introduction of the Constellation-class frigate will

[19] https://news.usni.org/2023/07/19/russia-says-all-ships-in-the-black-sea-heading-to-ukraine-are-potential-carriers-of-military-cargo

drive investment in the short term, but is expected to be counter-balanced by the retirement of the Littoral Combat Ships.

Client Spotlight: RENK Group AG (VMS & Military Naval)

RENK Group AG is a German provider of mobility solutions to the defence and industrial markets. Within the defence space (military armoured vehicles and naval surface and subsurface vessels), RENK is positioned on more than 180,000 platforms, and has supplied to 25 NATO countries.

Within VMS, the company provides transmissions, engines, suspensions, test systems and electric drives for tracked and wheeled military armoured vehicles at the new build, upgrade and overhaul stages of the lifecycle. RENK has supplied its products to more than 70 Armies. Figure 22 depicts RENK's primary VMS offerings:

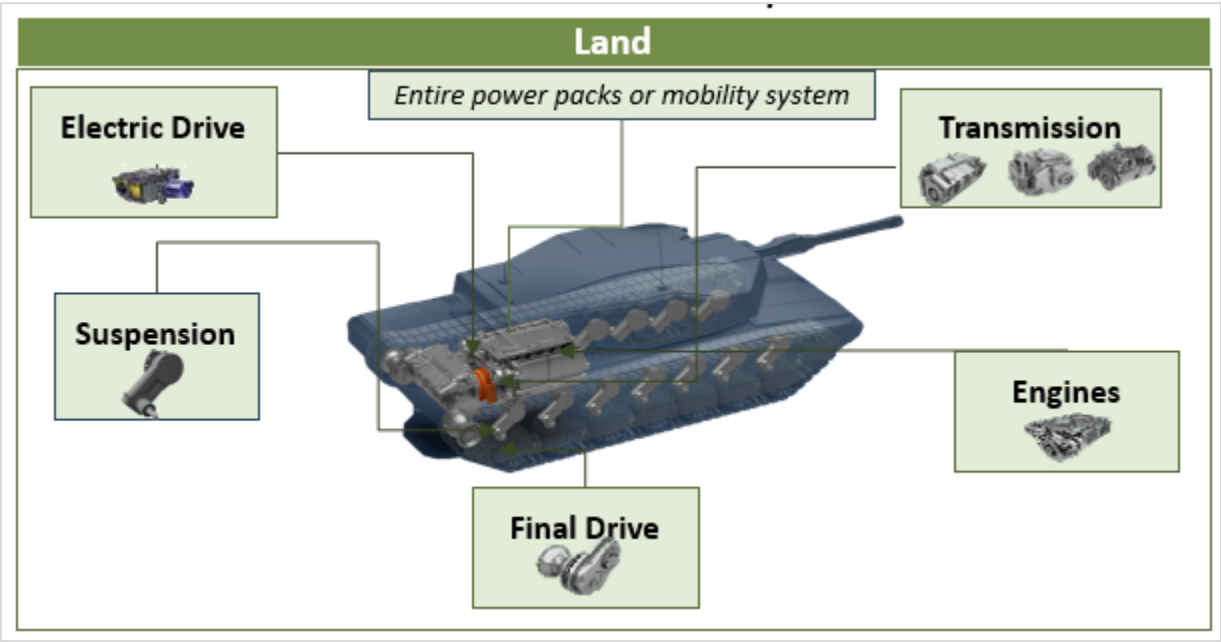

Figure 22: RENK's VMS Offerings

Within military naval, RENK provides naval gear units, clutches, variable frequency drives, gear systems, electric drives and slide bearings for surface and subsurface combatants, primarily within the new build phase of the lifecycle. RENK has supplied its products to more than 40 Navies & Coast Guards. Figure 23 depicts RENK's primary military Naval offerings:

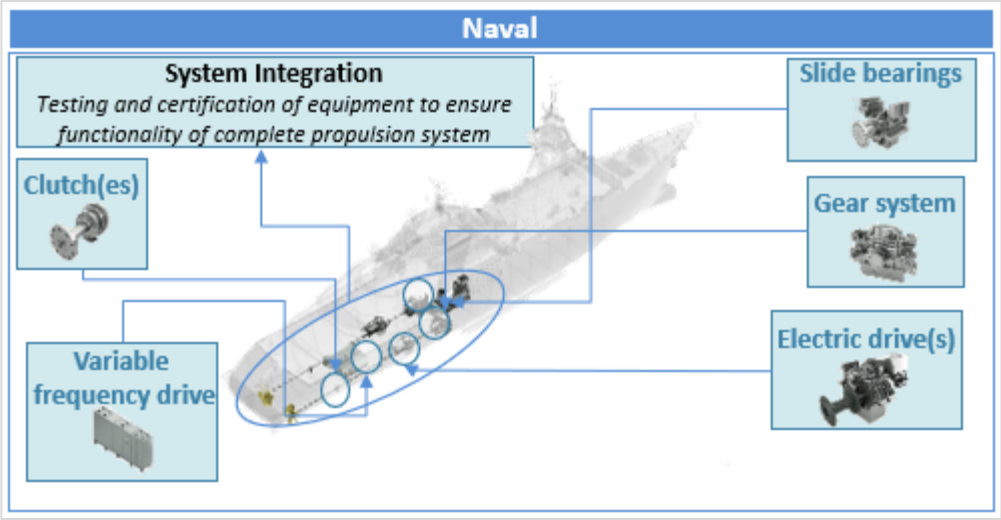

Figure 23: RENK's Military Naval Offerings

RENK Total Addressable Market (VMS & Military Naval)

The evolving requirements of both the armoured vehicle and naval platform markets create a variety of fast-growing opportunity for market participants. Due to ever-increasing customer demands that stem from the need to respond to very distinct and increasing threats and economic and political issues, suppliers must concentrate their efforts on specific platforms and customer sets within the universe of opportunity. This allows them to concentrate on key technology, product or mission areas where they may have the specific expertise or competitive advantage necessary to maintain and grow their market position. For example, RENK provides transmissions, engines, suspensions and electric drives for multiple types of tracked and wheeled armoured vehicles.

However, their products are focused onto the bespoke, purely military vehicles market, and are not suited to Commercial Off-The-Shelf ("COTS") vehicles. We have not, therefore, included such these vehicles as part of the addressable market. Within the naval market, RENK provides gear units for surface combatants and diesel electric submarines, as well as slide bearings for surface and subsurface combatants. However, RENK does not currently provide gear units for nuclear submarines, which we have therefore excluded from the addressable market. Figure 24 demonstrates the topline to total addressable market walkdown.

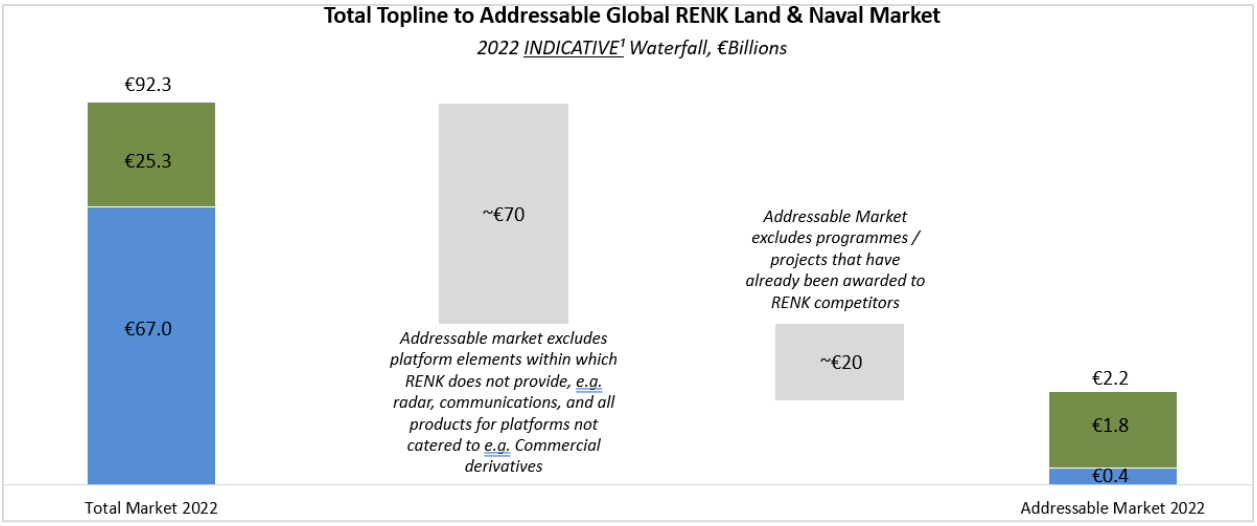

Figure 24: Total Topline to Addressable Global RENK Land & Naval Market

RENK's total addressable market excludes products not currently offered by RENK, e.g., ship and armoured vehicle hulls and platform electronics. It also excludes projects contracted to a competitor, wherein it is judged that there is little to no chance of the competitor being dislodged by RENK on the programme. Figure 25 shows RENK's addressable market from 2018-2027:

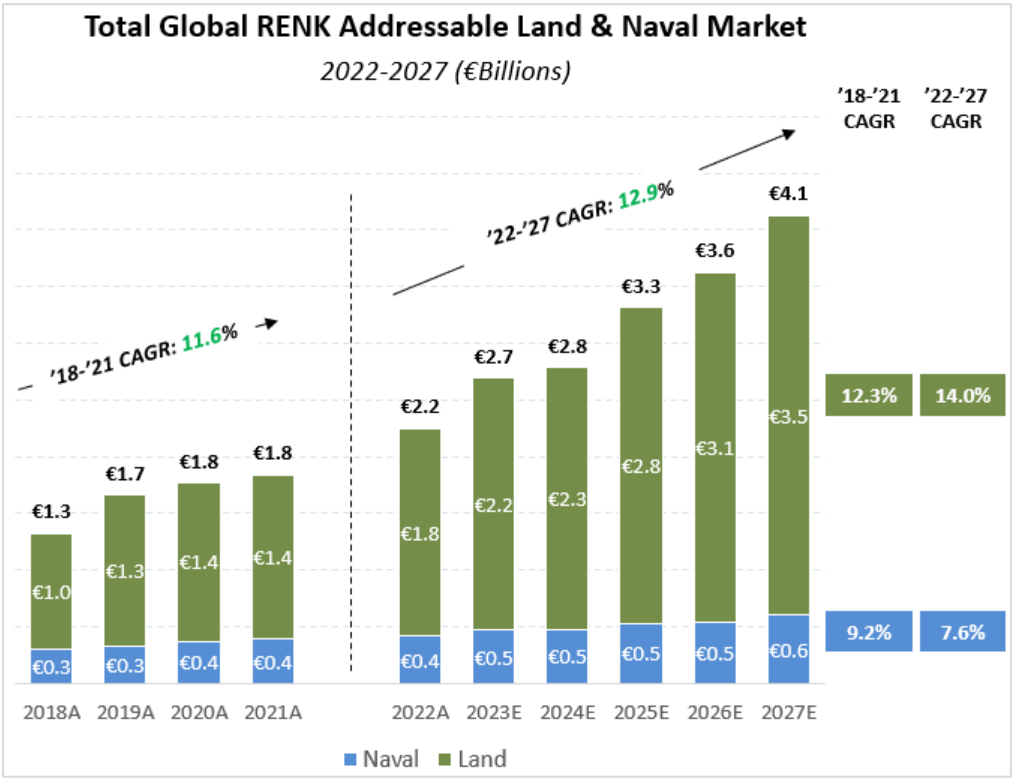

Figure 25: Total Global RENK Addressable Land & Naval Market

RENK's defence business is growing faster than the topline in both land and naval markets. From 2018-2021, RENK's total addressable market grow at a rate of 11.6%; from 2022-2027 this growth is accelerated to 12.9%, driven by land and naval fleet recap globally.

Client Spotlight: RENK Vehicle Mobility Solutions

VMS Total Addressable Market

RENK's Vehicle Mobility Solutions business provides mission-critical drive technologies for tracked and wheeled armoured vehicles. The Total Addressable Market ("TAM") for this segment is growing at 14.0% 2022-2027, faster than the overall market. This is due to renewed global investment in armoured vehicles, particularly tracked, as well as RENK's strong competitive positioning across customers and product sets. Customers in NATO and NATO-allied (Australia, Japan, Republic of Korea ("ROK")) are investing heavily in recapitalisation of their tracked vehicle fleets. This is, in part, the result of some key platforms with a high installed base (M2 Bradley, Leopard 2) nearing the end of their service life and needing replacement or a fundamental life-time extension programme. However, the conflict in Ukraine has demonstrated both the threat that Russia poses in Europe, and the battlefield utility of tracked platforms. Indeed, the TAM for tracked vehicles grows at 18.7% in the 2022-2027 period.

RENK is positioned on several platforms that are forecast for high growth in the near term, such as K9 and Leopard 2, which drives growth in the overall TAM over recent year. Growth in wheeled vehicles has been strong over recent years, driven by several key programmes in the US and Europe, including the Joint Light Tactical Vehicle ("JLTV") and Boxer. Near term growth is flatter as users focus investment on tracked platforms, wherein the majority of RENK's platform positioning lies. In future, users will continue to operate a mix of both tracked and wheeled platforms.

Figure 26 shows the addressable market for tracked and wheeled vehicles:

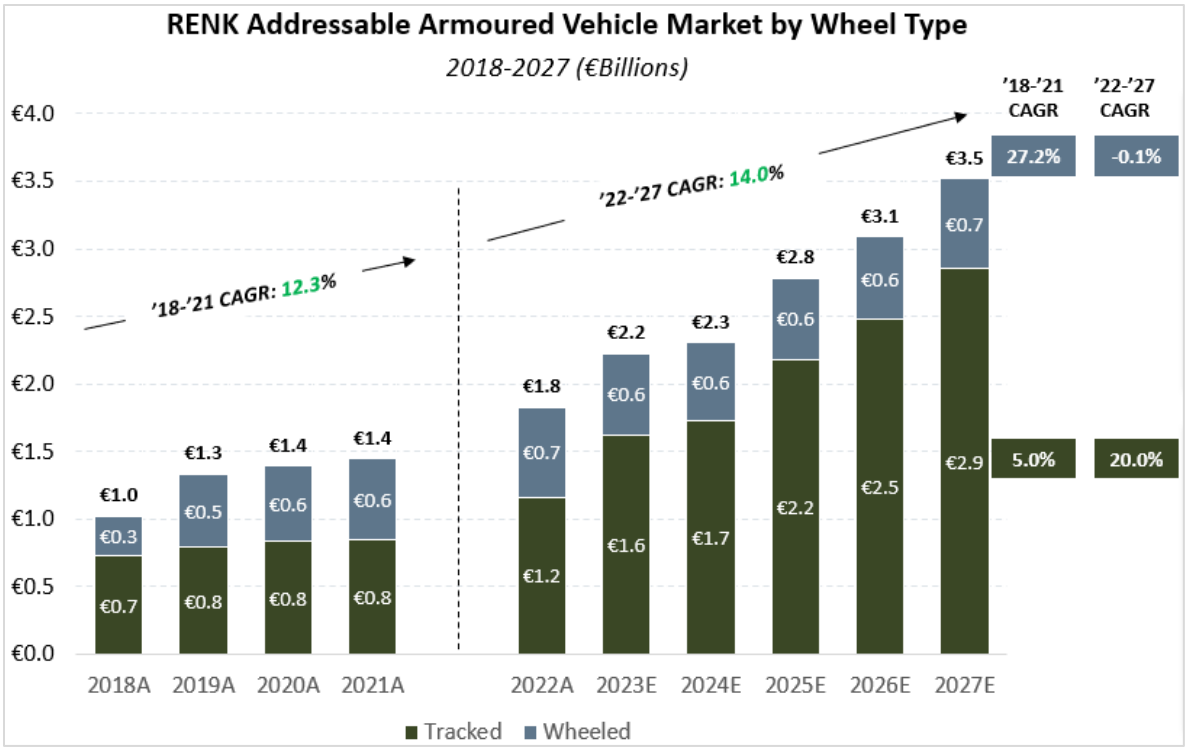

Figure 26: RENK Addressable Armoured Vehicle Markey by Wheel Type

The different stages in the armoured vehicle platform lifecycle facilitate multiple opportunities for RENK to participate. The lifespan of armoured vehicles spans 40+ years. Throughout that lifespan, RENK's products may be provided as new build, i.e., a brand-new system or subsystem for a new-build platform undergoing production. They may also be provided via aftermarket through both upgrade and overhaul. Upgrade refers to maintenance and repair of system component parts following initial wear and tear wherein basic functionality remains the same with only minimal changes; this is undertaken multiple times from ~5 years after the platform enters service. Overhaul refers to major refurbishment or retrofit of platform systems and subsystems, designed to improve the function of the system and overall platform, and is undertaken at ~5—10-year intervals through the platform lifecycle.

As armoured vehicles are undergoing increased wear and tear through usage and training operations, particularly in Europe, some users may seek to increase the frequency of upgrade and overhaul cycles, prompting strong growth in the aftermarket. Growth in the aftermarket, and RENK's ability to address platforms across families and origins, contributes to high growth in the overall TAM. Figure 27 shows RENK's armoured vehicle TAM by lifecycle:

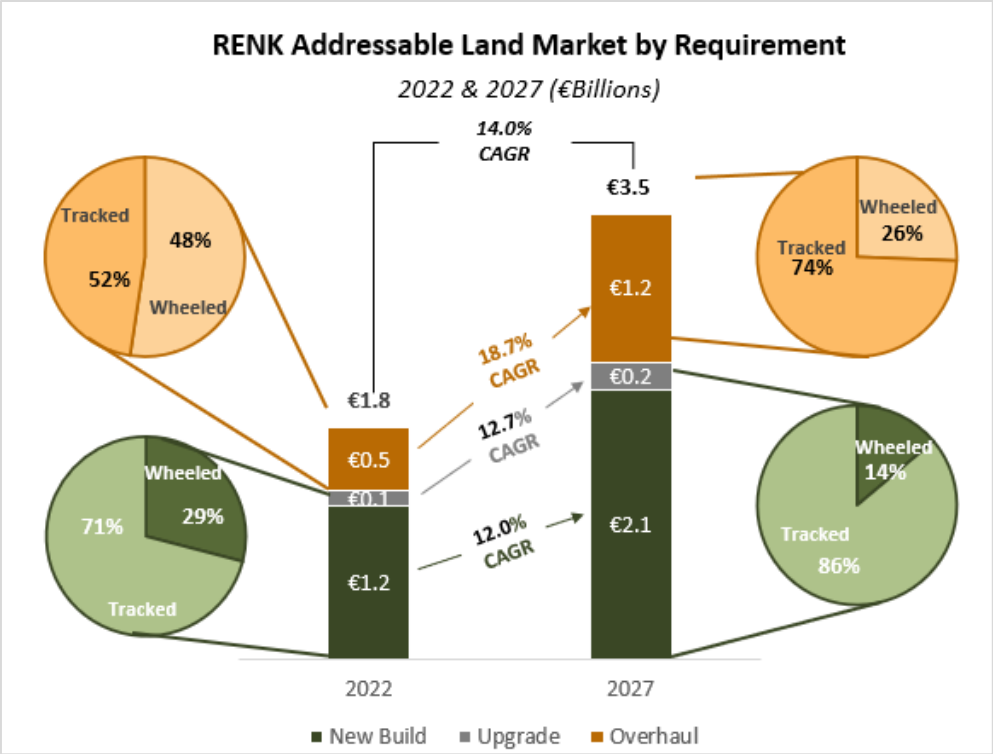

Figure 27: RENK Addressable Land Markey by Requirement

Transmissions are the largest product segment of the TAM, driven by strong growth in tracked vehicles, which form the vast majority of addressable platforms for this product. In 2023, the TAM for transmissions totals €1.1bn, growing to €1.8bn in 2027, driven by both new build and aftermarket opportunity. Engines are the second largest product segment in the TAM. RENK's current engine offering is aging, limiting new build addressability, though strong growth is driven by platform overhaul, upgrade and repowering (e.g., M60 in Taiwan) opportunities. In 2021, RENK acquired the Combat Propulsion Systems (CPS) engine business from L3Harris Technologies.

The suspension market is balanced across Europe and APAC; suspensions is a strong growth driver in US following RENK's acquisition of Horstman and General Kinetics. Hybridization (i.e., electric drives) is a small but fast-growing market likely only on next generation of vehicles such as XM30, as users seek to move toward hybrid electric propulsion. With RENK's acquisition of Magnet-Motor, more in-house competence and capabilities will bolster the latter as well.

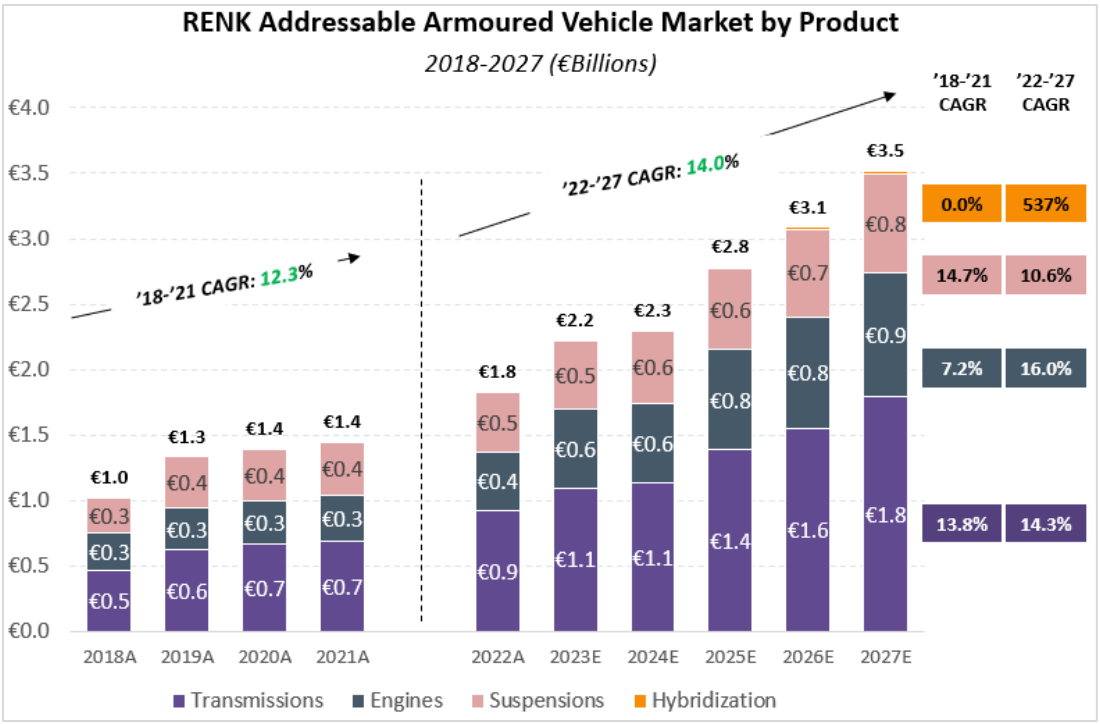

Figure 28: RENK Addressable Armoured Vehicle Market by Product

Europe is RENK's largest addressable market, as European users recapitalise their fleets of tracked and wheeled vehicles via overhaul and / or replacement and augmentation of their existing fleets. RENK's positioning on a number of key European platforms, such as Leopard 2, also informs the size and growth of the TAM in Europe. The APAC market is more conservative in size, though also sees strong growth. This is driven mostly by current and planned procurement in ROK, as well as Taiwan and Australia. Growth in the North American market is modest in the short term but will accelerate outside of the forecast period as XM30 production ramps in the late 2020s / early 2030s. Figure 29 shows RENK's addressable market by region:

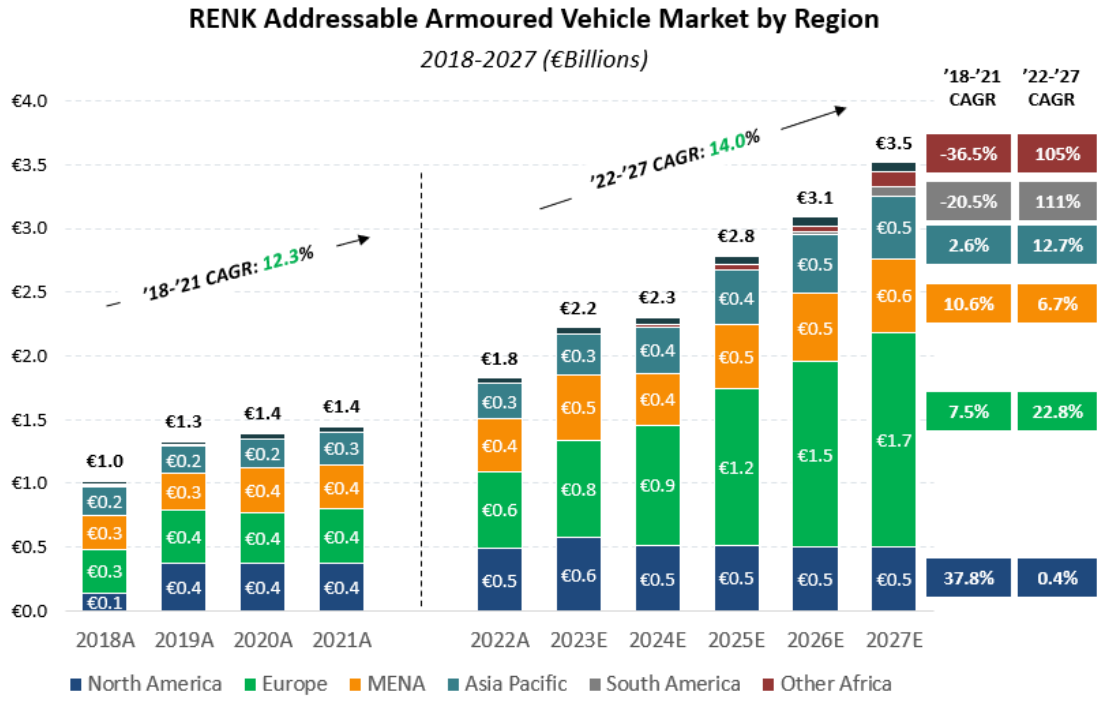

Figure 29: RENK Addressable Armoured Vehicle Market by Region

VMS Market Positioning

RENK is a leading provider of mission-critical drivetrain technologies; the company's product placement across platforms and geographies supports high growth in the addressable market. RENK is positioned[20] on 43% of the global tracked and wheeled armoured vehicle market as of 2022 (a total of more than 180,000 platforms and 40+ platform families), excluding embargoed countries and platforms of Russian and Chinese origin in service in second party nations. Their products have been supplied to over 70 Armies.

The company's positioning in tracked vehicles is especially strong, as RENK is positioned on 75% of the global fleet. MBTs, IFVs, and SPHs are to undergo sustained growth in demand through 2027 due to aging global fleets and the heightened threat scenario; in these categories, RENK has >50% product placement, rendering them a market leader in combat vehicles, and driving growth in the TAM that is higher than the winder market. Crucially, RENK is a provider on several key growth platforms and platforms with a high installed base, including Leopard 2, K9, M2 Bradley, Stryker and Boxer.

The company are well positioned via partnerships and customer relationships to capture platforms in development, including XM30 in the US and Main Combat Ground System (MCGS). Figure 30 shows RENK product placement as a percentage of the global fleet, excluding embargoed nations and Russian / Chinese platforms:

[20] Product positioning defined as presence of one or more RENK products on a platform. Figures given are as of end 2022.

Vehicle Type	Renk Installed Base	Total Installed Base	Overall Product Positioning[2]	Transmission	Engine	Suspension
Tracked Armoured Personnel Carrier	41,219	43,583	95%	0%	0%	95%
Tracked Infantry Fighting Vehicle	13,930	26,445	53%	39%	2%	44%
Tracked Main Battle Tank	12,970	24,842	52%	25%	30%	11%
Tracked Self-Propelled Howitzers	14,652	16,093	91%	10%	2%	86%
Tracked Support Vehicle	3,471	3,471	100%	10%	90%	86%
Towed Howitzers	1,137	1,137	100%	0%	0%	100%
Wheeled Armoured Personnel Carrier	4,613	15,279	30%	0%	0%	29%
Wheeled COTS Vehicles	45	23,471	0%	0%	0%	0%
Wheeled Heavy Tactical / Support	74,100	115,000	64%	0%	0%	64%
Wheeled Infantry Fighting Vehicle	9,613	19,135	50%	7%	0%	44%
Wheeled Light Tactical	4,658	98,168	5%	0%	0%	4%
Wheeled Medium Tactical / Support	0	119	0%	0%	0%	0%
Wheeled Self-Propelled Howitzers	0	3,754	0%	0%	0%	0%
Wheeled Specialised Protected Support	698	30,523	2%	0%	0%	2%
Wheeled Ultra Light Tactical	0	2,618	0%	0%	0%	0%
Total (inc. all tracked & wheeled)	181,240	424,224	43%	5%	3%	39%
Total Tracked	86,376	114,568	75%	16%	10%	63%
Total Wheeled	94,864	309,656	31%	0%	0%	30%

Figure 30: RENK's Product Placement

Geographically, RENK's VMS products are positioned globally; RENK has supplied more than 70 Armies with its products. The company's positioning in NATO is especially strong, as RENK is positioned on 61% tracked platforms. RENK's strongest geographies in terms of installed base are the US and South Korea, each investing in a number of high-volume tracked and wheeled platforms.

Region	Platform Type	Platform Families Supplied By Renk	Total Platform Families[1]	% Supplied by Renk
Europe	Tracked	32	54	59%
North America		16	26	62%
South America		6	15	40%
MENA		24	45	53%
Asia Pacific		24	62	39%
Other Africa		5	18	28%
Europe	Wheeled	8	82	10%
North America		8	35	23%
South America		3	21	14%
MENA		7	62	11%
Asia Pacific		9	63	14%
Other Africa		2	52	4%

Figure 31: RENK's Geographical Presence

VMS Competitive Positioning

Within VMS, RENK operates in a market with a range of competitors, including niche providers with focused product suits as well as scaled multi-product, multi-segment and multi-industry providers and vertically integrated OEMs with presence in the drivetrain market itself.

RENK's primary competitors within transmissions are focused providers of drivetrain technologies for defence and commercial platforms. Within engines, however, the primary competitors are scaled industrial providers whose primary focus is commercial heavy industry but have the resources and product set to compete in the armoured vehicle market. Figure 32 summarises RENK's primary competitors in the transmission and engine market:

Competitor	Tactical Vehicle Platform Presence												Combat Vehicle Platform Presence								Risk to RENK	Analysis
	Ultra-Light Tactical		Light Tactical		Medium Tactical / Support		Heavy Tactical / Support		Spec. Prot. Support		Industrial / Recovery		IFV / APC Wheeled		IFV / APC Tracked		Self Propelled Howitz.		Main Battle Tanks			
	Trans.	Eng.	Trans.	Eng.	Trans.	Eng.	Trans.	Eng.	Trans.	Eng.	Trans.	Eng.	Trans.	Eng.	Trans.	Eng.	Trans.	Eng.	Trans.	Eng.		
RENK			◕		◕		◑		◑		◔		◔		●	◑	◕		●	◑	N/A	• Provider of transmissions, suspensions and engines on wheeled and tracked vehicles
Competitor #1			◕		◑		◕		◑		◔		●		●		◑		◕			• Core competitor to RENK on future pipeline projects including OMFV, LAND 400, and new Borsuk platform
Competitor #2									◔		◑				◑		◕		◕			• Targeting K2 prod. lot IV where RENK incumbent • Won Altay MBT transmission contract
Competitor #3			◔	◑		◕		◕	◑	◕	●	●	◔	●	◕	◕				◑		• Strong ties to Competitor #1 • Gaining market share in RENK's primary engine segment
Competitor #4													◕		◕		◕					• Competitor to RENK on OMFV project • Focuses on hybridization; targeting next gen tracked combat platforms
Competitor #5																●		●				• Key competing provider of engines to US Army platforms
Competitor #6	◔		◕		◑		◑		◕		◑		●				◔		◔			• Minimal threat to RENK; limited presence in tracked in recent years
Competitor #7											◕				◔				◕			• Portfolio not compatible with heavy IFVs/APCs • No current hybridization capabilities
Competitor #8												●		◑		●		●		●		• Low overall threat; marginal transmission presence

Figure 32: RENK's Primary Competitors in the Transmission and Engine Segments

Only Competitor #1 is deemed a key competitor to RENK within transmissions due to their presence on a number of high-growth platforms with a large installed base, and potential presence on XM30. RENK's engine offering is aging, and providers such as Competitor #3 are gaining market share on the platform types RENK is positioned on.

Within suspensions, RENK's subsidiary Competitor #1 has the broadest and deepest access to market; other providers are more focused on contracts on families of tracked or wheeled vehicles. For example, Competitor #1 is positioned on Leopard 2, but have limited participation in other tracked vehicles, mostly notably IFVs or APCs. Competitor #2 provide suspensions for their own OEM wheeled platforms but have displayed no strategic interest in selling their suspension offerings onto non-OEM platforms.

Figure 33 summarises RENK's primary competitors in the suspensions market:

Competitor	Tactical Vehicle Platform Presence						Combat Vehicle Platform Presence				Risk to Horst-man[1]	Analysis
	Ultra-Light Tactical (Suspension)	Light Tactical (Suspension)	Medium Tactical / Support (Suspension)	Heavy Tactical / Support (Suspension)	Spec. Prot. Support (Suspension)	Industrial / Recovery (Suspension)	IFV / APC Wheeled (Suspension)	IFV / APC Tracked (Suspension)	Self Propelled Howitzers (Suspension)	Main Battle Tanks (Suspension)		
Horstman[1]		◑				◕	●	●	●	●	N/A	• Provider of transmissions, suspension, and engines on wheeled and tracked vehicles
Competitor #1						●		◑		●		• Direct competitor for future MBT contracts; incumbent on Leopard II and its derivatives • Limited threat in other key segments; no known IFV/APC pipeline programme participation
Competitor #2		●	◕	●	●							• Wheeled suspension only; limited threat in tracked • Key OEM contractor; future wheeled platforms likely to use self-supplied susp.
Competitor #3		◑			◑		◑	◕				• Direct competitor to RENK on platforms such as AMPV and latest M2 Bradley • Not sole supplier to any key future projects
Competitor #4												• Wheeled suspension only; limited threat in tracked • Access primarily to Europe and Nordics
Competitor #5								◕				• Direct competitor on European platforms; one of few non-RENK players offering rotary dampers • AJAX is main project
Competitor #6				◕				◑				• Wheeled focus; limited threat in tracked due to portfolio constraints • Partnership with German provider could be leveraged to access new platforms in the future

Figure 33: RENK's Primary Competitors in the Suspension Market

Client Spotlight: RENK Military Naval

Military Naval Total Addressable Market

RENK's military naval business provides gear units and slide bearings for surface and subsurface combatants. The TAM for this segment is growing at 7.6% in the 2022-2027 period, driven by renewed focus on the naval domain, particularly in Asia Pacific, as well as RENK's strong global competitive positioning, particularly in large surface combatants; this helps to drive growth in the TAM that is faster than the wider market. Customers in Asia Pacific are investing heavily in surface combatants. This is primarily due to concerns regarding Chinese incursion in the region.

Chinese posturing with regard to Taiwan and aggression in the South China Sea have exacerbated allied regional concerns regarding the threat, particularly from NATO-allied peers such as Australia, Japan and ROK. This concern has prompted investment particularly in anti-surface, anti-submarine and anti-air warfare capabilities, concentrated in large surface combatants such as destroyers and frigates. Indeed, the TAM for large surface combatants grows at 9.3% in the 2022-2027 period.

Growth in the submarine market has been strong in recent years as users seek to satisfy Anti-Submarine Warfare ("ASW") and Anti-Surface Warfare ("ASuW") requirements. Near term growth is steady, likely to grow further in 2030s as initiatives such as AUKUS ramp up. Naval applications only require limited aftermarket services given the nature of vessels and difficulty to conduct aftermarket services on products that are integrated so deeply with the vessel. Therefore, the vast majority of RENK's value is accrued in initial product delivery. Figure 34 shows RENK's TAM by vessel type:

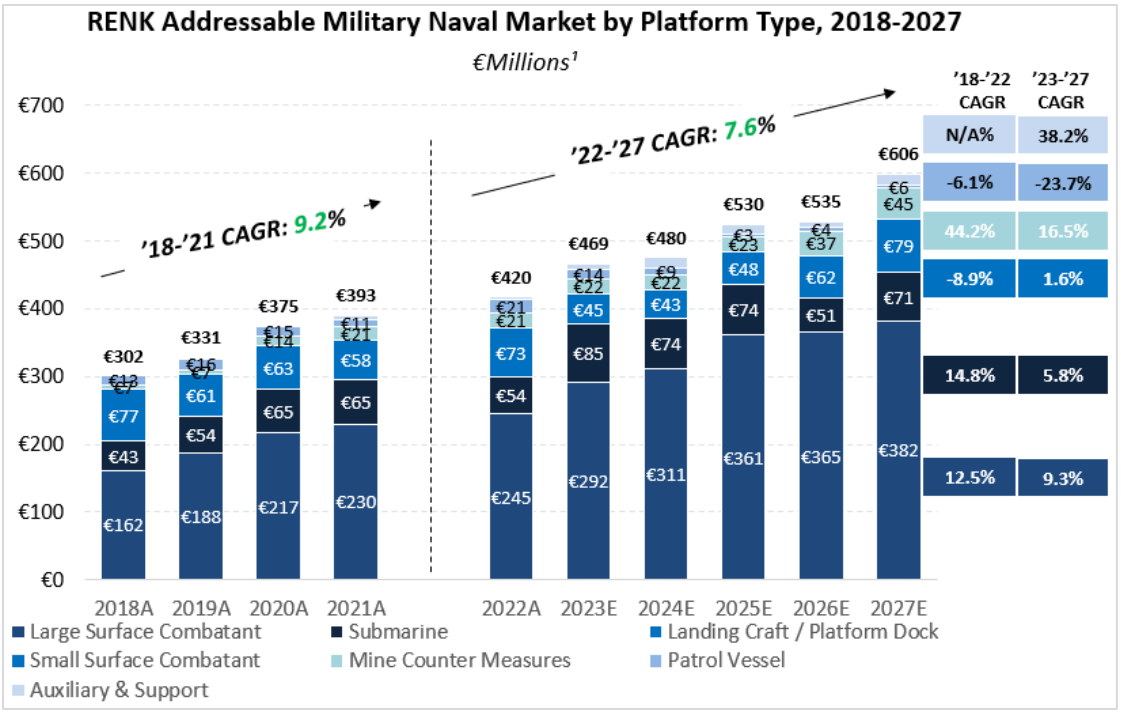

Figure 34: RENK Addressable Military Naval Market by Platform Type, 2018-2026 (€M)

Large Surface Combatants account for 58% of market in 2022; this is expected to increase to 63% by 2027, driven by near peer threat set and the need to replace aging platforms. Within the surface combatant market, there is a growing emphasis on multi-role, adaptable platforms with modular equipment to be reconfigured for different missions, including multi-mission corvettes and frigates, which comprise ~80% of the TAM for large surface combatants in 2022. Figure 35 shows the breakout of the TAM by vessel sub-type:

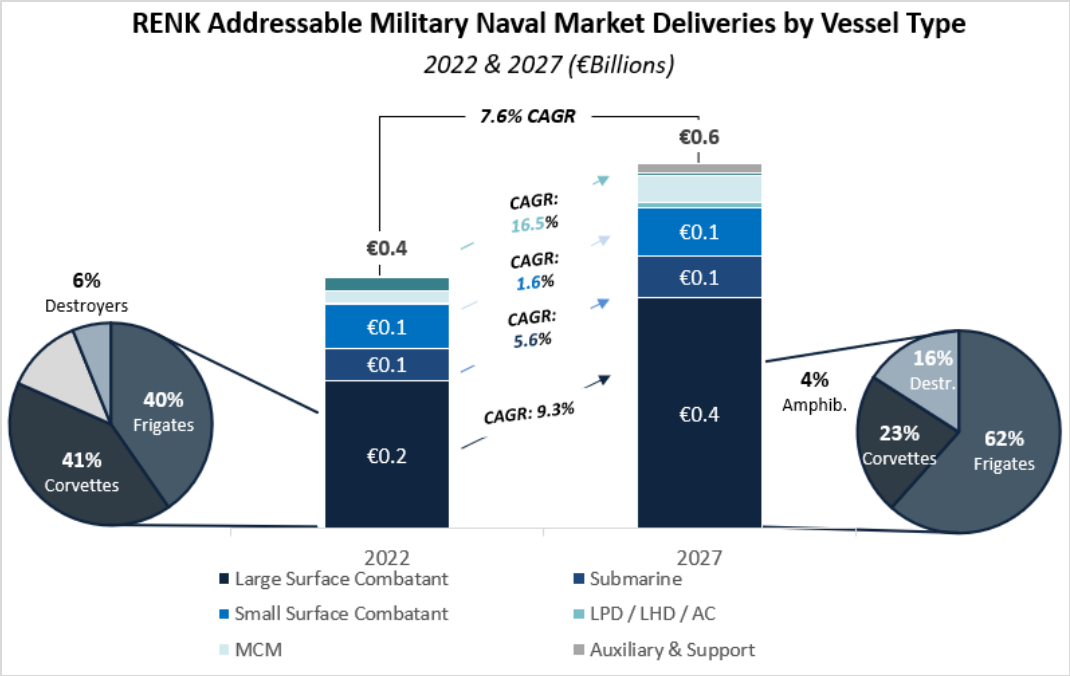

Figure 35: RENK Addressable Military Naval Market Deliveries by Vessel Type, 2022 & 2027 (€Bn)

The military naval TAM is primarily being driven by investment in Asia Pacific, which accounts for ~60% of the market in 2022-2027. Strongest spenders within the region are ROK, Japan and Taiwan, whose investment is concentrated in Large Surface Combatants including frigates and destroyers, driven by resurgent Chinese threat. RENK's addressable North American market is lower in the short term, but likely to to grow substantially in early 2030s as FFG Batch II and DDG(X) deliveries begin. European growth driven by variety of surface and sub-surface programmes, including German, French and Nordic programmes. Figure 36 shows RENK's naval military TAM by region:

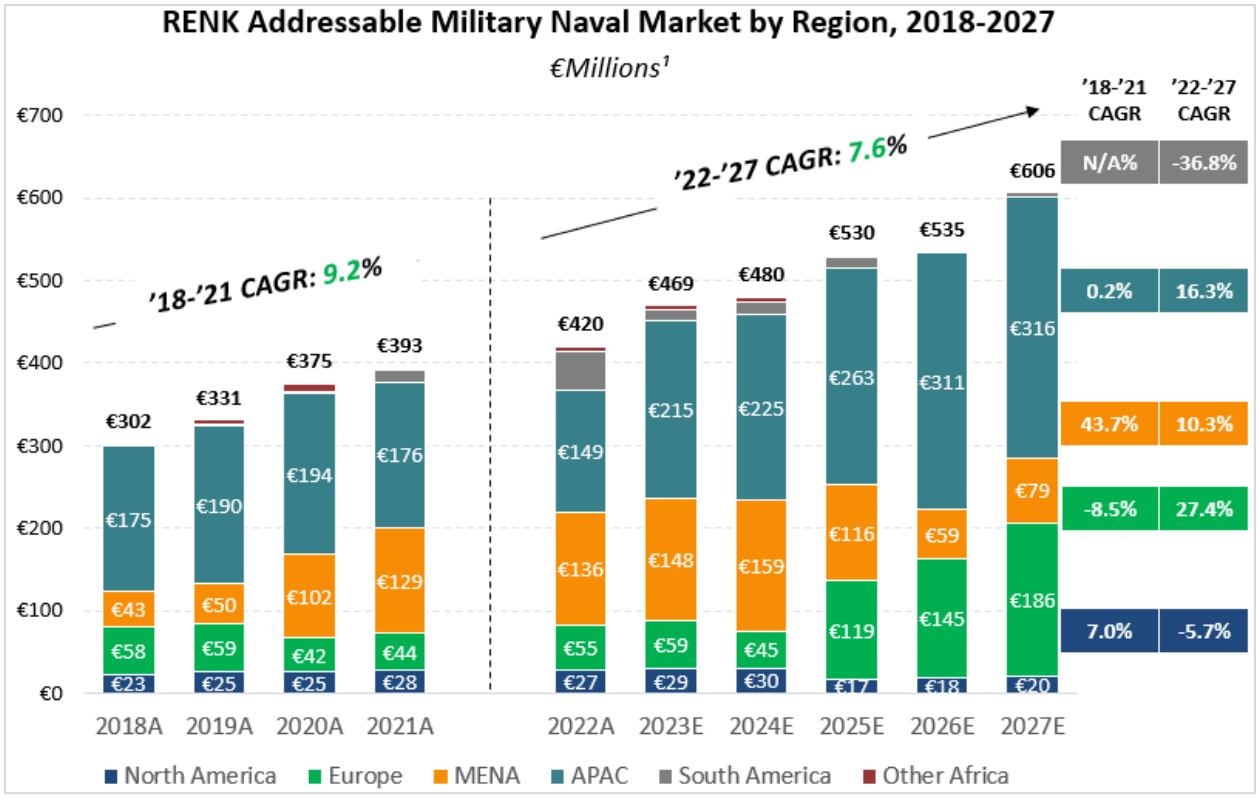

Figure 36: RENK Addressable Military Naval Market by Region, 2018-2027 (€Bn)

Military Naval Market Positioning

RENK is a leading provider of naval gear units; the company's product placement across platforms and geographies supports high growth in the addressable market. RENK is the global leader of gear units for Large Surface Combatants, with presence on 32% of the global installed base as of 2022, excluding embargoed countries and platforms of Russian and Chinese origin in service in second party nations. RENK's installed base as of 2022 totals more than 200 Navy and Coast Guard platforms, and RENK has supplied more than 40 Navies and Coast Guard. Crucially, RENK is a provider on key platforms with a high, and growing, installed base, including the German-designed MEKO family of vessels and Type 31 in the UK. Figure 37 shows RENK gear unit product placement as a percentage of the global fleet, excluding embargoed nations and Russian / Chinese platforms:

Vessel Type	Overall Gear Unit Placement	RENK Installed Base	Total Installed Base
Large Surface Combatant	31.6%	137	434
Mine Counter Measures	8.9%	11	123
Small Surface Combatant	7.9%	53	674
Submarine	5.6%	10	178
Auxiliary & Support	3.1%	1	32
Patrol Vessel	2.0%	8	405
Landing Platform Dock / Landing Helicopter Dock / Aircraft Carrier	1.6%	1	64
TOTAL	**11.6%**	**221**	**1910**

Figure 37: RENK's Product Placement by Platform Type

Military Naval Competitive Positioning

Within the military naval space, RENK operates in a market with a range of competitors, including niche providers of mechanical parts as well as vertically integrated OEMs with presence in the gear unit and slide bearings market itself. Across its naval portfolio, Competitor #1 is the only competitor offering similar breadth and depth to its product lines, though the company's offerings are focused on Large Surface Combatants, wherein RENK's portfolio spans vessel types. RENK's primary competitor within gear units for large surface combatants is Competitor #3, a marine gear unit provider focused wholly on the US market. Figure 38 shows RENK's competitors by product portfolio and platform:

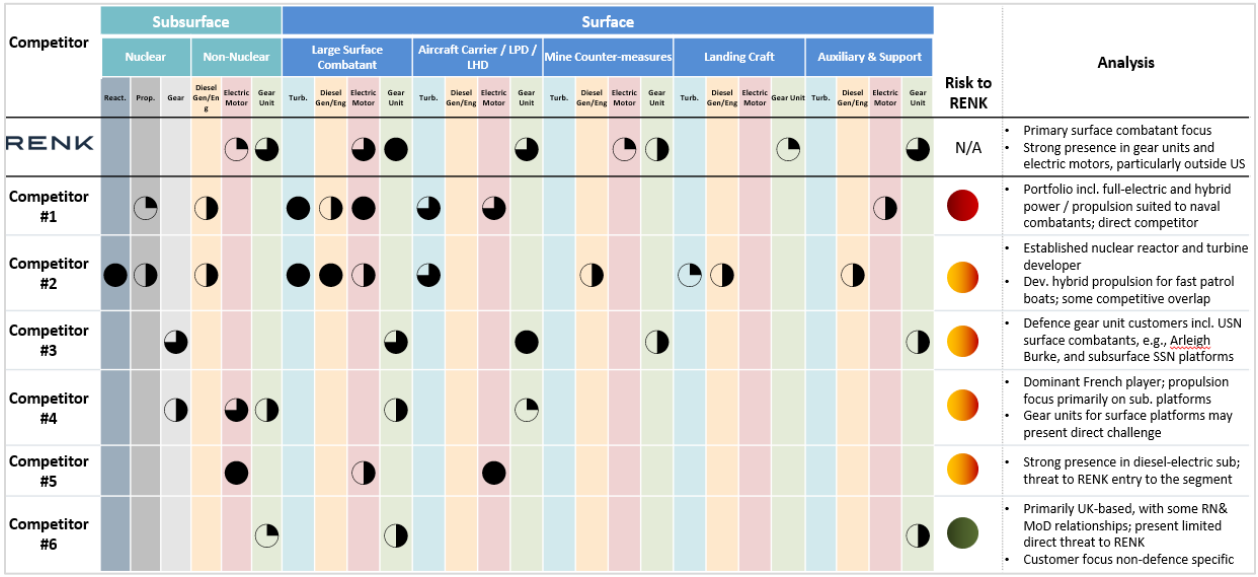

Figure 38: RENK Military Naval Competitive Positioning:

<End>

Renaissance Strategic Advisors is a leading consultancy that supports senior corporate executives and investors in the global defense, space, commercial and business aviation, intelligence, and government services sectors as they address their most complex and critical issues. Our strategy, market assessment, and M&A due diligence services are founded upon world-class domain expertise, multidisciplinary skills, judgment, and trust.

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Contact us to see how we can help your leadership team achieve their strategic objectives.

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