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Conventional (AIP) Submarine – a Weapon of Choice for the 21st Century

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Introduction

The potential implications of shifting US interests/military doctrine from the Atlantic to the Pacific, and more specifically to South-East Asia, as well as the superpower ambitions of China and its growing tension with neighbours demands a closer look from the global security and defence industry. The US military solution for national security challenges from the Asia-Pacific (APAC) region is the Air-Sea Battle strategy. In a potential worst-case scenario, where the US Navy has to confront the Anti-Access / Area Denial operational concept of its adversary(ies), Frost & Sullivan anticipates a significant role for conventional submarines in the confrontation.

The modern non-nuclear, conventional diesel-electric submarine (SSK) with air-independent propulsion (AIP) system is a complex, multi-role and extremely powerful weapon system. The submarine is able to deploy a wide range of weapons such as: torpedoes, anti-ship missiles, land attack missiles, mines, unmanned underwater vehicles, self defence systems and even provide accommodation and support for a team of Special Forces. Consequently, the vessel can conduct various missions from anti submarine, anti surface vessels warfare through land strikes with cruise missiles to intelligence, surveillance and reconnaissance operations. Therefore, modern SSKs can play the role of a semi strategic weapon which will have a decisive effect on future air-sea battlefields.

Naval operations have changed significantly compared to the Cold War period. Operations at sea have moved from the "blue water" open ocean to the "brown water" shallow, costal environment. As a result, the importance of smaller and quieter conventional submarines has significantly increased. The SSK will play an important role in the Anti-Access / Area Denial operational concept of countries such as China, North Korea or Iran that aim to block access to combat zones and increase their adversaries' naval vessels' vulnerability to lethal attacks.

On the other hand, detecting, tracking and locating SSKs is a challenging task, even for the most advanced Navies. For instance, the US Navy has constantly struggled to effectively detect diesel-electric submarines. In 2005, the Gotland Swedish AIP-equipped submarine was leased with a crew to the US Navy. During a war gaming exercise with the USS Ronald Reagan Carrier Strike Group on December 2005, the Swedish submarine penetrated the defence of a carrier battle group and managed to "sink" the aircraft carrier, while remaining undetected. Similarly, US vessels have often experienced such defeats at the hands of the South Korean type 209 and 214 SSKs during the biannual Rim of the

Pacific Exercises. These examples and other features discussed in this Market Insight establish the modern SSK as a powerful adversary particularly in littoral warfare.

AIP A 'Must' Feature for the Modern Submarine

One of the key disadvantages of diesel-electric submarines is the snorkelling required to charge its batteries, which exposes SSKs to passive and active counter detection sensors. A partial solution to the SSKs' Achilles heel is the implementation of AIP systems on the submarine boards. The AIP comes from Hellmuth Walter's engineering genius and was developed during the II World War. Right now, there are three AIP technologies on the market – fuel cells, Stirling engines and MESMA (Module d'Energie Sous-Marine Autonome).

Table 1: The most common AIP systems used by modern SSKs

	Fuel Cell	Stirling Engine	MESMA
Shipbuilder	Howaltswerke-Deutsche Werft GmbH	Kockums AB	DCNS
Power (kW)	9x34 2x120	2x75 4x75	200
Advantages	very quiet, low operating temperatures, highly efficient,	low acoustic radiation, mature technology, low life-cycle cost	very quiet, high output power, no diving depth limitation
Disadvantages	the heaviest system, special refuelling infrastructure is needed	relatively large size, operation to 200 metres diving depth	high oxygen and fuel consumption, relatively low efficiency, noise gas management method

AIP increases the submerged endurance from days to weeks because it allows recharging batteries without snorkelling. The system can extend the submerge mission period of SSK three-fold, depending on the technology and mission profile. As a result, AIP offers significant tactical advantages over standard conventional diesel-electric submarines that are not equipped with the system. Another important feature of AIP is that the technology can be relatively easily integrated into already operational standard submarines during retrofit.

Although, the submerge endurance of AIP SSK cannot be compared with nuclear-powered submarine as yet, the AIP technology is evolving rapidly and more reliable and powerful

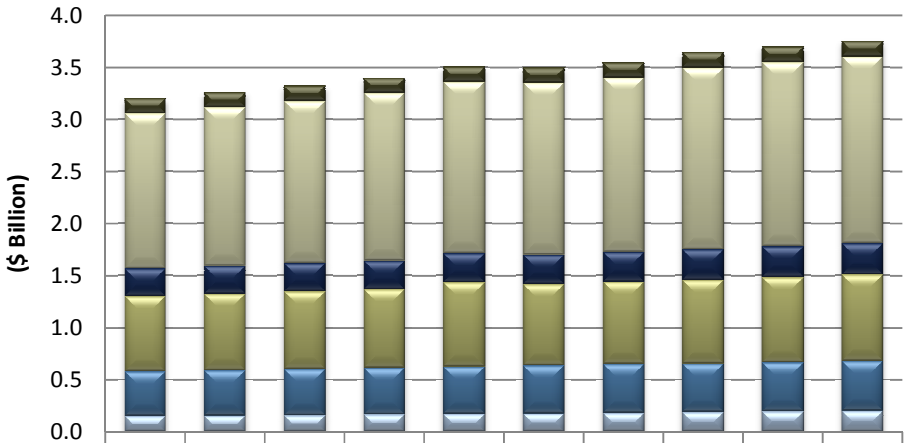
AIP solutions can be expected within a decade. Consequently, AIP system is seen as a must-have capability for newly procured SSKs. Additionally, the through-life cost of SSK AIP, in comparison to nuclear-powered attack submarines (SSN), is about three to four times lower, not to mention the high cost related to deactivation of nuclear-powered submarines.

Due to all these factors, there is growing interest from a number of countries to purchase or build AIP SSK, especially from APAC.

Market Potential

According to Frost & Sullivan, despite the implementation of austerity measures and defence budget reductions in many countries, the demand for conventional submarines, mainly with AIP on board, will grow at a compound annual grow rate (CAGR) of 1.8 per cent during 2013-2022, and present revenue opportunities of up to $34.80 billion to the industry.

Figure 1: Conventional Submarines, Market Size Forecast by Region, Global, 2013-2022

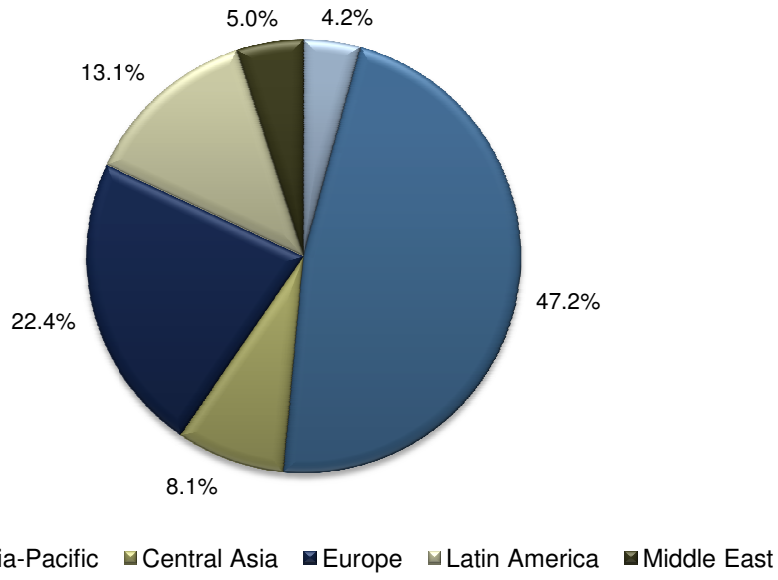


	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Africa	0.14	0.15	0.15	0.14	0.14	0.15	0.15	0.15	0.15	0.15
Asia-Pacific	1.49	1.52	1.55	1.61	1.65	1.65	1.67	1.75	1.77	1.79
Central Asia	0.27	0.27	0.27	0.28	0.28	0.28	0.29	0.29	0.30	0.30
Europe	0.72	0.73	0.75	0.75	0.81	0.78	0.79	0.80	0.82	0.83
Latin America	0.43	0.44	0.44	0.45	0.45	0.46	0.47	0.46	0.47	0.48
Middle East	0.15	0.15	0.16	0.16	0.17	0.17	0.18	0.19	0.19	0.20

The North American market for SSK is anticipated to be near negligible over the forecast period. Heavy reliance on nuclear-powered submarines in the US, and the fact that Canada procured second-hand British Victoria-class submarines at the beginning of the century, leaves limited or no market potential for new SSK in the region. However, Canada could consider implementing AIP systems for their submarine fleet to increase operational capabilities.

In contrast, the APAC and Europe seem to be two the most attractive markets at present in terms of the market size. It is expected that the SSK market in APAC will grow at a CAGR of 2.1 per cent and will be responsible for 47.2 per cent of the global demand for conventional submarines. The high CAGR is reflective of the arms race fuelled by China's growing ambitions and border disputes in the region. Further, APAC countries are in the process of expanding their underwater capabilities with stealthy SSKs. All main Navies in the region are implementing submarine programmes: China (Yuan class), India (Scorpène-class and Project 75I), Japan (Sōryū class) and South Korean (Son Won-il U214 class and expected DSX3000 programme). Bangladesh's recent announcement on a submarine procurement plan further confirms the trend.

Figure 2: Conventional Submarines, Cumulative Market Share Forecast by Region, Global, 2013-2022



Europe, with CAGR growth of 1.5 per cent and 22.4 per cent global market share, will retain its status as the second largest SSK market. Stable demand for submarines from the region is the consequence of ongoing projects that were implemented before the economic

downturn. The most prominent ongoing SSK projects are underway in Germany and Italy (Type-212), Greece and Turkey (Type-214) and Spain (S-80). Additionally, Sweden has been developing its new submarine – A26 project, Norway is looking to replace its Ula class SSK, and Poland wants to enter two modern AIP submarines into service by 2022. Thus, Europe and APAC offer attractive prospects for the submarine markets during the forecast period while the rest of the regions analysed, offer a modest potential.

Conclusion

The modern submarine (AIP SSK) is a very strong threat to any surface and submerged adversary due to its tactical flexibility, stealth, small size, and the new operational paradigms. Navies are increasingly looking to modern SSKs due to its multi-role capacities and semi-strategic potential. Consequently, modern conventional submarines present significant market potential for the submarine sector, both in terms of the sale of new boats as well as the opportunities to retrofit standard SSK with AIP plug-in. The Pacific region has the most heavy sea-lane traffic in the world, which needs to be constantly secured and, therefore, will offer considerable market growth opportunities for submarine solutions providers.

From the financial point of view, AIP SSK is about three to four times cheaper to procure and operate when compared to nuclear-powered attack submarines. Therefore, in the long-term perspective, even the traditional nuclear-powered approach of US Navy should be taken under revision due to budget constraints. The potential of AIP SSK as an alternative, for at least partial replacement of the Los Angeles class nuclear-powered attack submarines, should be thoroughly assessed.