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A MANNED SUBMERSIBLE WORLD

WILL KOHNEN

*Chair Manned Underwater Vehicles Committee
Marine Technology Society*

Since 1960, the global manned submersible industry has provided safe, technologically advanced, and secure Manned Underwater Vehicles (MUVs) for military, research, commercial, and tourism markets. Many of the specific innovations developed in our sector, especially in the areas of engineering design, material science fabrication, and technology have had a positive impact across the marine (autonomous, ROV) and aerospace sectors. These contributions, along with the outstanding safety record of MUVs, are testament to a committed group of manufacturers and operators focused on operational excellence and professionalism, all fueled by a spirit of innovation, exploration, and discovery.

Historically, there have been a total of 365 MUV submersibles built around the world. Since 1995, the industry has seen a dramatic period of growth and innovation. Much of this growth can be directly linked to advances in materials technology, especially acrylic, which can now be used to manufacture transparent hulls up to 12 inches thick. Today there are 165 active vehicles, half of them rated to 500 m or deeper. Twelve are rated to depths greater than 2000 m, of which seven were built in the last 20 years alone. Significantly, 62 of the active subs (over half) were built in the past 10 years. Notably, 33 of these newer submersibles are centered on an all-acrylic hull, with 23 of them rated to 1000 m.

Along with material innovations, our MUV industry is responsible for developing 11,000 m rated Lithium-Ion battery technology, which is now a standard for all un-

derwater vehicles—AUVs, ROVs, etc. In addition, the industry has seen a proliferation of subsea expeditions for science, research, and discovery over the last 18 months. Manufacturers, including Triton, Seamagine, and U-Boat Works, among others, have been involved with significant missions around the world. The *Five Deeps Expedition* is the first manned descent to the bottom of each of the planet's five oceans. This fully classed two-person submersible traveled 47,000 miles and completed 39 dives.

Advances in materials, batteries, navigation and controls are all trends over the past few years that influenced the growth and innovation currently being observed in our industry. In the past, MUV industry hubs have been centered in North America, Europe, and Japan. Recently, we have seen expansion worldwide, particularly in the Indo-Pacific region. Future technological advancements will incorporate increasingly advanced systems; artificial intelligence; advanced energy storage; supercapacitors; advanced DC motors; enhancements in navigation systems; and underwater sensors. Ultimately these technologies will cross platforms, from manned to unmanned.

This year, the United Nations declared the start of the Decade of Ocean Science with plans for the SEABED 2030 endeavor to map the ocean floor, and all industries are challenged to contribute. With only 15 percent of the seafloor mapped so far, great expanses remain, a task most suited to unmanned vehicles. However, mapping seabed ecosystems themselves will require further examination, and the

ability of MUVs to provide in-situ, intelligent assessments will no doubt play an important role in transporting the scientific community to an ever-greater depth of understanding.

The MUV COMMITTEE, a global organization of operators, manufacturers, and support services, meets yearly at the Annual MTS MUV Symposium. Next year, the conference will be held at Woods Hole Oceanographic Institution, in late Spring, and we look forward to discussing the next chapter in the story of MUVs.

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