Regionally Deployed Adaptive Platforms for Ocean Science

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***Abstract*—**Global Oceans is a US-based nonprofit organization designed to develop and operate innovative infrastructure solutions to the challenge of sustaining and expanding ocean science capacity globally within an increasingly resource constrained research environment. The differentiating operational strategy for achieving this objective is the selective chartering of offshore service vessels (OSVs) for short-term use as oceanographic research platforms; together with installed, project-defined modular labs and instrumentation on deck; and remote logistics support to enable regional expedition deployment.

***Keywords*—**Research vessels, offshore energy sector, research collaboration, expedition planning, public-private partnerships, resource optimization.

I. Introduction

The increasing utilization of autonomous technologies like AUVs, remote sensing from space, and continuous *in-situ* monitoring technologies (e.g. buoy arrays, drifters, etc.) for gathering ocean and atmospheric data continues to shape the role that research vessels play in oceanographic research [1]-[2], with some analyses suggesting that this trend portends a qualitative shift away from the need for research vessels [3].

Fully functional research vessels however will continue to be an essential component of ocean science, driven by the need to support complex, process-driven and experimental research and sampling throughout the world's oceans [9]. Remote deployment of autonomous vehicles and on-going maintenance of buoy arrays will also require adequate availability of ocean-going platforms.

Nevertheless, cuts to public science funding in recent years, and on-going fiscal constraints in the US and Europe, continue to put pressure on the ability to sustain high-cost infrastructure such as dedicated research vessels [4]-[8]. These antagonistic trends, the continuing need for research vessels against increasing resource and funding constraints, set the stage for new infrastructure models to emerge through novel approaches and partnerships that are more adaptive and less capital-intensive.

The use of existing infrastructure from the commercial private sector, notably from the offshore energy industry, for oceanographic research is one such approach. The SERPENT program, for example, has partnered with oil companies to allow use of deep-sea oil-field Remotely Operated Vehicles (ROVs) installed at drilling sites by visiting scientists [10]. The scientific use of donated ROV time through this program has provided valuable knowledge about new species and impact assessments of seafloor drilling on benthic fauna [11]. Use of these resources however is tethered to the physical sites where they are installed and is subject to use only when these resources are in "stand-by" mode.

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II. Network Infrastructure Paradigm

The concept of utilizing existing resources such as ships, ROVs, AUVs and other assets from the offshore energy sector more broadly to expand ocean science capacity is a tantalizing one, long recognized by the science community as an alternative infrastructure model, albeit one where efficiency, safety and cost issues were undefined [12]. In response to the growing need for ocean-going research infrastructure, and to more fully leverage the wealth of resources present in the global offshore energy supply chain, Global Oceans has developed an integrated expedition management model which operationalizes this potential called MARV, for Modular Adaptive Research Vessel. It provides a functionally flexible and scalable research vessel capacity supplemental to existing dedicated R/V fleets. Global Oceans is currently developing an expert management support team and engaging with the global science community and others to align and leverage this capacity with existing projects and new research initiatives.

The differentiating operational strategy for achieving this objective is the selective chartering of offshore service vessels (OSVs) for short-term use as oceanographic research platforms; together with installed, project-defined modular labs and instrumentation on deck; and remote logistics support to enable regional expedition deployment. This "network" model optimizes the configuration and planned use of distributed, outsourced assets for research. It creates an alternative, demand-driven infrastructure paradigm which eliminates the significant capital investment and annual operational costs associated with owned vessels, together with the geospatial limitations of fixed-point dedicated assets and long transits to deployment ports.

While the temporary conversion of non-research vessels for science is not entirely new, the unique aspect of the Global

Oceans approach is the standardization and cost-optimization of this method and the alignment of high quality supply partners across the commercial field to ensure routine, predictable availability of research-configured vessels in response to research needs. This approach leverages access to a global pool of over 3,000 offshore service vessels from multiple vessel fleets, ranging from 30m to 90m in length, widely distributed geographically for short-term time-charter and mission configuration (**Figure 1** and **2**).

Figure 1 Project-configured OSV with labs, storage, on-deck accommodations & operational support

Figure 2 Modular lab systems on deck

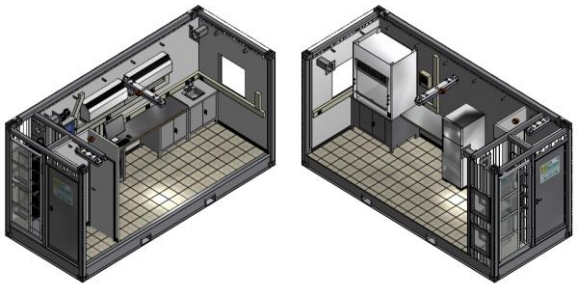

Figure 3 Modular Lab System – Chemical Analytics Lab configuration (split interior view) – *Note dual door entry for interior environmental control*

Modular laboratories, workshops and auxiliary accommodations are acquired from a distributed global pool, shipped to the departure port for installation, and instrumented for each science mission (**Figure 3**). Remote local logistics are supported by a global port services partner providing project management offices in over 1,500 ports within 112 countries, for pre- and post-expedition operations and secure receipt of advance shipments of science assets.

Vessels can be committed and organized months in advance or within short timeframes on the order of weeks for surge capacity needs and for study of temporal phenomena. They are mobilized within the region of study, and adapted specifically to support the scientific objectives of each expedition.

Collaborative engagement with the ocean science community to enable planning, alignment and funding of these capabilities within discrete projects and proposals is integral to ensuring the productive use of this model. To support this process, Global Oceans is developing a secure online planning tool called GOCEPT for scientists to explore and define ways that research assets and new technologies can best be integrated into field work, including on a collaborative and shared-cost basis.

This tool provides a GIS-enabled platform that integrates expedition research planning with geospatial mapping and modeling of in-field activities; an interactive forum for work scheduling and collaborative resource sharing among science teams; and a technical resource database. Research technology suppliers will be invited to host their technical product and support data within the planning tool for access by scientists in the planning phases of their research.

III. Leveraging Expanded Capacity – A Proposed Indo-Pacific Transect

The expanded, adaptive infrastructure and research capacity afforded by the MARV model will enable greater access to remote, understudied and deep-sea environments. Such new capacity can in turn catalyze new proposals and funding for research and exploration. An example is a new proposal now in development by Global Oceans for a multi-year annual transect in the Indo-Pacific Ocean region being proposed as a joint project with Indonesia together with a network of Indonesian academic institutions.

The analogue for the program is the Atlantic Meridional Transect (AMT), an annual research transect between the UK and the South Atlantic. The AMT has supported a highly productive multidisciplinary research agenda encompassing biological, chemical and physical oceanographic research over its 18-year series of annual voyages [13]. AMT provides a platform for national and international scientific collaboration, a training arena for the next generation of oceanographers, and a testbed facility for new technologies, a strategy that will be replicated for the Indo-Pacific program.

The new Indo-Pacific proposal will be enabled by the MARV model, which opens up a resource pool for open ocean research not otherwise available in the region. Nearly a third of the world's offshore service vessels available for charter by Global Oceans operate in the region, many of which are Indonesian-flagged vessels. The Indo-Pacific Ocean is simultaneously one of the least accessible and poorly studied

regions, and the most biodiverse within the world's oceans [14]. This project is exemplary of how the Global Oceans approach can accelerate our understanding of biodiversity in this important region, and contribute to global data sets monitoring and modeling climate change.

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