COMMENTARY

Navigating Regulatory Frameworks to Benefit From the State of Diving Technology and Techniques

AUTHORS

Michael Lombardi

Robert Mirick

Co-Chair, MTS Diving Committee

Paulstephen Chierico

Secretary, MTS Diving Committee

Introduction

The state of diving technology and techniques has been considered extensively by both past and present Marine Technology Society (MTS) Diving Committee leadership, recognizing that while technology has evolved considerably, so too have barriers to entry caused by regulatory disparities among and between occupational diving sectors and their respective frameworks, leaving new diving technology adoption (for work) in a confused state. In a recent survey of MTS Diving Committee members, which extended to other international trade associations in the field, a consensus recognized that advancements in diving technology recently outpaced contemporary diving safety policy and operational procedures. The MTS Diving Committee view actions to close this gap as the absolute priority in diving technology today for safety, establishing operational practices, and evolving regulations.

In 2022, the Diving Committee codified its position via a Code of Practice to guide occupational diving practitioners through developing and/or adopting technology and techniques into their underwater work operations by providing a logical framework to navigate potentially complex and sometimes conflicting regulatory, compliance, health and safety, training, and proficiency concerns commonly present in diving program management (Lombardi et al., 2022). This framework is intended to align with broadly accepted regulations and practices throughout all diving community sectors in both academia and industry.

The results of this codified position resulted in the MTS adopting new organizational policy 5200, reading as follows:

> *It is the position of the Marine Technology Society (MTS) for events occurring with MTS funding, endorsement, sponsorship, or through other brand association that engage [manned] diving, that all divers (contractors, company personnel, etc.) meet applicable regulations and operate in a manner consistent with local safe practices. Diving activity at MTS events may include but are not limited to: launch/recovery of instruments, sensors, or vehicles; setup of underwater obstacles or targets; conducting underwater photo or video documentation; demonstrating diving equipment or technology; and diver interactions with other non-diving marine technologies. In all such instances, MTS considers the diving purpose is mission/task oriented, and therefore occupational in nature. As such, any diving activity should be executed according to a pre-prepared safety plan, approved by the local organizers of the event, and, at a minimum, follow guidelines detailed in MTS Publication "A Code of Practice for Diving Program Management: Select Guidelines for Applying Technology in Occupational Diving Projects."*

The text below is excerpted from the MTS Code of Practice publication, providing context for future discussions as organizations and individuals consider adoption of new diving technology. The MTS Code of Practice is an approach to managing opportunities and risks, allowing the practitioner the latitude to embrace their own field of "Diving Science" for the purpose of mission enhancement and improving safety.

Context and Significance

Diving, operations involving an individual submerged underwater in greater than one atmosphere ambient pressure, is inherently a technology-dependent activity. Beyond breath-hold durations, humans cannot function

underwater without technology. Arguably then, diving technology enables underwater human endeavors in circumstances that necessitate intimate firsthand experience/judgment and other direct interactions through personal observation, dexterous manipulation, and spatial awareness. For the foreseeable future, this interaction will be required to guide forward progress of humankind's evolving relationship with the Blue Planet we all share, as well as to inspire the human element within, and guide the growth of the Blue Economy.

This technology is the fundamental commonality within all diving pursuits and between all diving communities. Historically, diving has been broadly classified as "occupational" (for work) or "recreational" (for sport). In more recent years, however, several communities of practice have emerged within each classification, largely defined by the scope of work or given tasks commonly associated with each community. Specialization within each community has resulted in distinct regulatory requirements, formal consensus standards of practice, as well as regionally accepted though informal best practices. These policies are generally directly keyed to the type of technology (and techniques) most routinely employed to conduct the specific tasks that define the respective community. Additionally, the distinction between occupational and recreational diving has become blurred in some instances, particularly with the emergence of organized citizen science programs, as well as public safety programs. Exploration in all diving sectors also contributes to blurring the binary notion of either occupational or recreational distinction, since both exploration and citizen science programs may be "voluntary" to the extent diving performed is not compensated, that is, work is performed pro bono by individuals and not by commercial divers for hire. Even so, all mission-driven diving practices have tangential associations with—and offer potential benefits to—academia and industry, particularly in the development of new technology and/or advancement of associated techniques.

It is important to recognize that the value of technology and techniques commonly employed within a community sector is not necessarily exclusive to that user community, nor is their utility limited to just one user community. *The technology does not define the community, rather it is the task or scope of work; to be clear, the technology of choice has been selected because of its value to the work as well as its appropriate mitigation of risks associated with the given scope.* Additionally, the argument that a "commercial diver" is someone hired to dive and perform the required task whereas all others are in other professions and dive as an ancillary duty to the profession is fundamentally flawed. Within each user community, there are individuals specifically engaged to perform underwater work—in some cases, this is in exchange for financial remuneration; in others, it may be for some other bartered benefit; and still in others, it may be completely voluntary. In all cases, compensated or not, the final decision to make the dive is made by the diver, though of course the repercussions of not making the dive may vary depending on the nature of the engagement.

Given the current trends in more diversified use-cases for diving, the MTS Diving Committee believes that international and national regulations and standards of practice would benefit from renewed scrutiny that better reflects contemporary diving community activities.

The distinct user communities are largely decentralized in their routine practice and infrequently cross-communicate. As such, when a unique circumstance or issue outside of the routine operating regimen surfaces within a given community, technology/techniques and expertise are not always shared, and therefore, efficient problem-solving and community progress overall stagnate. This is evident, for example, in how slow diving technology has evolved—very, very little has changed in fundamental life support technology for more than 100 years. The two seminal life support modes of surface supplied (air or mixed gas), and Self Contained Underwater Breathing Apparatus (open or closed circuit), are still the mainstay of the diving equipment manufacturer industry. Tangentially, the progress of manned submersible technology, when considering (one) atmospheric diving, is outpaced by development of technologies dedicated to unmanned undersea systems.

Purpose and Intent

As specialized underwater problems present themselves that require human intervention, it is critically important for diving communities to recognize where expertise (technology and techniques) common in one user community may be the solution to a problem needing to be addressed within another user community. Why reinvent the wheel? While communities are decentralized, a reasonable diving program manager or diving contractor should recognize that each user community has established precedent and safe operating

practices for the nature of their work including operational procedures, training, and vetting the dive team. It is therefore important to avoid stigmatizing any given community and, instead, consider a tailored approach to problem-solving for potential application of new technology or of new techniques elsewhere within the diving community writ large.

A tremendous opportunity exists now to bridge the gap between these diverse and diverging communities. Consider instances where the successful development and application of proven technologies and techniques can be shared, risk managers can be better educated on safe practices, techniques emerge that improve productivity, training is enhanced for improved retention by personnel, significant time is saved for vetting work projects, and lowered costs drive more commerce at scale to create a substantially more viable diving industrial base. Therefore, the MTS Diving Committee's purpose and intent is to catalyze crucial cross-community cooperation and communication through its Code of Practice and related outreach activities, which together will provide a framework to better align disparate diving community activities.

Diving Community Challenges

When occupational diving communities do engage cooperatively either directly or through the sharing of technology and techniques, numerous examples of complex issues become raised, which often relate to regulatory challenges and the practical management of associated risk. Up until now, these issues tend to present themselves on a per-project basis and in specific circumstances.

In many instances, memoranda of understanding executed at administrative, or management, levels can help delineate the burden of risk management and associated liability within a diving operation. However, a challenge often remains at the deck plates, where diving program managers or safety officers lack a universally recognized baseline or framework to align standards, practices, and diver qualification vetting between two or more diving communities. Such a framework would present a logical tool to guide and assist administrative and management's navigation of risk mitigating decision-making.

For illustration purposes, consider 10 exemplar hypothetical examples of challenges faced within occupational diving:

1. A scientific organization requires deep technical diving to collect samples, in 200 fsw. The lead investigator, a scientist, has not maintained proficiency in deep technical diving. Deep (sport) technical divers who are proficient in the techniques can conduct the work cost-effectively; however, they may likely not meet the requisite standards of the scientific organization that are imposed on its employed scientists or technical staff. The diving program manager has brokered an agreement in principle to use sport divers to complete the scientific diving tasks; however, a gap is that a framework is missing to vet the divers to a recognized reference baseline needed to delineate issues of liability and risk management in terms both partner groups understand. Consequently, the scientific organization may not benefit from acquiring data from this environment.
2. A commercial diving company requires employment of a specific scientific instrument to gather data at a work site. The commercial diving company does not have the know-how for instrument use, end of dive day preventative maintenance, and troubleshooting. The operator/technician for the instrument may be a perfectly competent sport diver with on-the-job experience in proficiently operating the instrument underwater; however, he/she is not trained as a commercial diver. The diving program manager has brokered an agreement in principle to allow the technician to operate the instrument during routine diving tasks; however, a gap is that a framework is missing to vet the diver to a written recognized reference baseline needed to delineate issues of liability and risk management in terms both partner groups understand.
3. A group of local citizen scientists is gathering data of significant scientific merit, on a volunteer basis, without pay. The lead scientist's sponsoring consortium may not permit volunteer divers to work within their program. The scientist lacks the funding necessary to employ large groups of personnel dedicated to gathering field data, long term. The diving program manager has brokered an agreement in principle to use an academic institution as a non-traditional partner to fold-in the local diving cooperative as students in a sanctioned educational program to complete

the diving tasking, as long as all parties register and a nominal tuition is paid up front. However, a gap is that a framework is missing to vet the divers to a written recognized reference baseline needed to delineate issues of liability and risk management in terms both partner groups understand.

4. A team of archaeologists from multiple organizations need to assemble a dive and science team to explore a shipwreck site. None of their home organizations have a formal diving safety program. Members of the cooperative team do have the expertise to manage diving safety though the host organization needs to be educated on how to effectively manage this project. It is understood that to be qualified for field work, divers must minimally provide documentation of dives logged/past experience, successfully complete a checkout dive, and maintain an updated fitness-to-dive clearance. Also, a written release from liability for the organization and proof of diver certification copy is kept on file. As volunteer divers, there are strict rules about not removing anything from the site and not sharing information about the sites outside the organization, which may be viewed as proprietary data to the project, despite the effort being clearly scientific in nature and not commercial diving per se. However, a gap is that a framework is missing to establish a dive program management structure for the Host Entity of the project to a written recognized reference baseline, which is needed to delineate issues of liability and risk management in terms all participants understand.
5. A team of natural history filmmakers requires scientists to participate in manned underwater vehicle operations for a documentary. The scientists' home organization is not inclusive of manned underwater vehicle training or proficiency. The filmmakers do not have a formal diving safety program, and the in-water safety dive team as well as a topside emergency vehicle recovery team add complexity to this operation. The manned underwater vehicle operators do not offer training for vehicle-diver interaction. The film crew producer has brokered an agreement in principle to allow the vehicle technicians to operate in the vicinity of the safety divers and the team of underwater camera-divers. However, a gap is that a framework for diving project management of divers from multiple parties is missing, causing confusion about delineating issues of liability and risk management.
6. A military exercise reveals an abandoned minefield exists in an underwater park. Scientists and technologists are required to deploy instrumentation for mapping and detection experimentation. Due to the presence of unexploded ordinances (UXO), the On Scene Commander of the project to document the site is assigned to the military, by law. The military does not have a mechanism for civilian scientific diving within this program scope. The appropriate scientific organization for the diving involved does not have a provision for conducting operations in the vicinity of UXO. The U.S. Coast Guard Officer serving as the diving program manager has brokered an agreement in principle to use the technical support of the civilian scientists and their specialized equipment to complete the diving tasking, as long as all parties sign a Memorandum of Agreement that limits the liability and indemnifies the non-government participants. However, a gap is that a framework is missing for the diving program manager to verify qualifications of the civilian divers to understand how their participation may safely align with the military divers.
7. The recreational boating industry requires divers to conduct routine hull maintenance tasks. This is a fast-paced business, often requiring operations with a small, low-impact footprint. Techniques from the recreational SCUBA community are embraced as the best mode of intervention, though this commercial work is often carried out alone. Despite an impeccable safety record for decades, regulatory agencies have cited companies within this space for non-compliance with established commercial diving regulations during rare incident occurrences. Other diving communities may benefit from the technology and techniques within this community; however, a gap exists where there is no framework for dive program management within this diving community that would present an opportunity

to gather data on safe practices, thereby defining the community sector and further educating other sectors on its unwritten but inherently safe and versatile techniques.

8. An engineering firm employs Professional Engineer personnel that dive within the scope of their employment. The divers engage in underwater surveys within an industrial waterfront to gather structural inspection data for a future municipal development of public interest. The divers have not attended a commercial diving school but do have recreational dive training and considerable experience. A gap exists where on-the-job training should be defined for the diving personnel who must be trained and maintain proficiency on the specific techniques required for safely diving in industrial waterfronts. The company would benefit from a framework to implement an on-the-job training regimen in concert with industrial diving experts to ensure diving personnel are trained in the most appropriate modes to mitigate hazards within this environment.
9. A university loses a lightweight seabottom instrument more than 100 fsw that can be readily recovered by hand. The instrument's deployment and recovery support a nonproprietary data collection of public benefit. The university's divers are capable of diving in excess of 100 fsw for scientific purposes within existing programmatic frameworks and with a minimal footprint; however, they are not expert in search and recovery methods. A local commercial diving contractor, expert in search and recovery, is retained, though due to the depth, it is required to have a hyperbaric chamber on location during the dive, which drives recovery costs up exponentially—it is decided to abandon the instrument. Publicly funded data are lost, as are university assets. A gap exists where the university diving safety program has not proactively educated the scientific officer on regulatory requirements faced if certain project risks present themselves, resulting in shorting the budget. The University would benefit from a framework enabling industry-academia consultation between diving sectors, and consequently advancing cooperative interests in adopting advanced techniques.
10. New technologies are developed by the private sector that are marketed as useful scientific or industrial tools. The inventors are qualified divers who have completed some initial pool-testing of their technology that shows promise, but they lack formal dive program affiliations typically required for access to a larger population trial via reciprocal diving privileges to achieve more rigorous beta-testing and operational evaluation. The challenges impeding an injection of new technology or techniques from one user community to another's diving operational concept are many. To get a technology that works in one user-community (left mesa) to transition over to the other user-community that might benefit too (the right mesa), the gap must be "bridged." To bridge the gap, a written recognized reference dive program framework is needed to align partner groups and thereby leverage the team's expertise for cooperative benefit.

Diving Science Defined

With the development and application of diving technology (and/or techniques) central to the cross-community cooperation required to address some of the aforementioned challenges, navigating these complexities is a scientific field unto itself ("diving science"). The MTS Diving Committee's Code of Practice is then a framework for program and project structure that supports diving for this purpose—to bridge the gap that often impedes transition of technology (and techniques) from one user-community to another and, ultimately, to improve data-gathering and the transfer of knowledge in the field of diving science for its advancement. Since MTS is an international organization with headquarters in the United States, the Code is modeled to meet the Scientific Exemption to OSHA 29CFPR1910 Subpart T (Commercial Diving Operations). It should be noted that Health & Human Services (HHS) 45CFR46 related to Human Subject Protections may at times be cited as cause for exemption to the commercial diving regulations for purposes of equipment testing or gathering health-related data (such as decompression sickness [DCS] incidents); however, the HHS 45CFR46 does not provide any guideline for safe diving practices nor diving program management. As such, this Code leverages the well-practiced scientific exemption, affording an individual, company, institution, or other project Host Entity following this

Code to be generally compliant with this scientific exemption.

Projects undertaken for commercial or exploitative purposes where the technology and techniques are not being introduced for data acquisition in furtherance of a scientific or experimental body of knowledge would not meet this scientific exemption, though they would still benefit from leveraging this Code for project organization and establishing a baseline framework for diving program management and diving safety risk mitigation. Similarly, the Code provides a framework that may be embraced internationally by non-domestic entities that are not bound by U.S. laws and U.S. regulatory requirements.

Corresponding Author:

Michael Lombardi, CMarTech
Co-Chair, MTS Diving Committee
E-mail: michael@lombardiundersea.com

Reference

Lombardi, M., Max, M., & Mirick, R. 2022. A Code of Practice for Diving Program Management: Select Guidelines for Applying Technology in Occupational Diving Projects. Marine Technology Society (MTS) Diving Committee Publication, p. 56.