All organizations are exposed to risk. How these risks are identified and addressed range from a proactive to a reactive approach. Despite the enviable diving safety record enjoyed by the scientific diving community, accidents still happen. The potential costs of a crisis include people, property, income and goodwill. Organizations want to avoid these costs but often devote inadequate time and attention toward developing a strategy to address them throughout all levels of their organization. This paper describes the principles of risk management and their importance in dive program management; outlines the considerations and tools of risk management; applies risk management principles to scientific diving programs; and describes how to develop a strategy for coping with incident management.

Introduction

In 2009, the authors were tasked by the AAUS (American Academy of Underwater Sciences) BoD (Board of Directors) to create a PowerPoint presentation on risk management. The intent was to create a product that could be used in two ways. First, by AAUS to train new DSOs (Dive Safety Officers) and second, as a training resource to provide to AAUS organizational members as a member benefit for use within their diving safety programs.

The resulting Risk Management PowerPoint was presented to the BoD and to a group of Diving Officers at the 2009 AAUS annual symposium and was approved by the BoD. This paper serves as a resource document for the PowerPoint, providing context and background so that it may be more effectively used by DSOs and the AAUS. The PowerPoint consists of three modules, the Principles of Risk Management, Applying Risk Management to Scientific Diving Programs and Incident Management.

Why should RM (risk management) be taught? Risk in scientific diving programs is not a theoretical concept, it is an operational occurrence. Egstrom (2006) stated “We will never be without risk in diving but we must use reasonable care in determining the degree of risk we are prepared to accept.” RM must be taught and practiced with due diligence. It is an important management tool that must be updated and used as part of the daily diving operation.

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How RM is taught will vary and each module can be adjusted to the needs of the target audience. For example, higher level administrators with demonstrated knowledge of RM principles might be presented with the first module as a review. Non-diving personnel may have a rudimentary knowledge of diving, so more thorough grounding in modules two and three may be appropriate. Personnel with duties to assist in emergencies and crises will likely benefit from an in-depth briefing on module three, combined with an overview of site-specific emergency protocols. Diving Control Board members, DSOs, and dive program staff are good candidates to receive all three modules in some depth and detail. The PowerPoint session is deliberately divided into these three distinct modules to allow for such flexibility in delivery and to build on prior learning.

Principles of Risk Management - Module One

When the term risk management is used, many people immediately think of finance and insurance. It is certainly an application of RM but financial risk is only part of the picture. Broadly speaking, risk is anything that threatens the organization’s mission and RM can be described as a discipline or process for dealing with uncertainty. In simple terms, RM is about identifying risks and deciding what to do about them. Can all risks really be identified? That is unlikely given that all risks are not created equal. RM is not a static assessment. Weather, sea conditions and the financial marketplace are all dynamic environments so RM must be a management process used on a daily basis. The most important thing about an organization is its mission and its most important resource its people. The most important decisions organizations make are how it uses its resources to achieve its mission. RM helps us protect our mission and resources by guiding the decision making process.

Risk Management is a Process

What are we trying to accomplish; what or who are we trying to protect; what are the priorities; and what will our strategy be to implement the plan and monitor and update it? Typically organizations will want to reduce or prevent injuries and incidents, avoid costly legal claims, preserve the reputation of the organization, free up resources for mission-critical activities and ensure adequate risk financing. The first step is thus to identify these answers and set goals.

Next, risks need to be categorized and prioritized. What and/or who are we trying to protect? Commonly this includes people, property, income and goodwill. There is a need to keep things in perspective so that action items can be put in priority order.

The next step in the process is to evaluate the risk. This is done by identifying what the hazard or risk is and providing a description of the risk event. Then the risk position can be evaluated by examining both the probability and the severity of an occurrence. Finally, a plan is formulated to mitigate or mediate the risk.

It is important to emphasize the two-dimensional nature of evaluating the total risk position (i.e., examining both the probability and the severity of a risk event). An excellent example of this two-dimensional aspect can be seen in Figure 1, which provides a qualitative approach of using colored quadrants to represent low, medium and high levels of the risk position. This graphically demonstrates that even when the likelihood of an incident is low, if the consequences of such an incident are high, the risk position is in the yellow “caution” area and steps should be taken to mitigate or mediate that risk. For example, even though it is very rare for a high pressure cylinder to catastrophically fail (low likelihood) the consequences of such an event are high and can result in great risk to life and property, so the resulting risk position is one that requires we take preventive action.
Noel Hinners (pers. comm., 2010) opined that “One must also recognize that [these types of] diagrams are simply a means of visually summarizing the risk assessments; in and of themselves they do nothing else. Behind them is the whole process of risk management. The figures are a useful way to sum up the prime risks and stimulate discussion. Experience shows that there is a lot of room for disagreement as to whether a particular risk belongs in a particular 'box.' That aside, it sure does focus one on critical risks. If a risk is in the high consequence (e.g., death, loss of mission) and low probability, one better pay attention to it and implement risk reduction approaches. The NASA shuttle accidents demonstrate that in a very forceful way. The reports of the accident investigations are sobering and demonstrate the consequence of ignoring risks that are staring you in the face.”

The next step in the process is to develop a strategy and then monitor and update the plan. Recall that RM is a dynamic process and change is challenging, i.e., this process must be ongoing.

There are four techniques that are generally used in a RM strategy, including avoidance, modification, retention and sharing. Avoidance is for when the risk is too high, such as when an organization has insufficient resources, training, equipment, supervision and/or safety measures to complete a mission. Retention is when the organization assumes the risk (e.g., $1,000 deductible on an insurance policy). Modification is a technique that is used frequently in diving programs and is effective when there is a way to do something safely by simply changing the way it is done. Policies and procedures are developed just for this purpose. Sharing is another technique and is commonly done through a contract, such as a caterer that has insurance policy coverage working at a venue, which also holds insurance coverage.

Before applying this process to AAUS organizations, the categories of risk must be examined. People are clearly a high priority for any ethical organization and, unlike property, they cannot always be “made whole” again. The long-term impact of a serious injury often extends well beyond the person injured and can have lasting negative effects on other members of the organization. Another category of risk is goodwill or the reputation of an organization. Crises can tarnish the image of an organization, impacting their customer base, bottom line, ability to secure funding or simply the degree to which they have influence in their community or industry. These two categories of risk alone can have a profound effect on an organization.
The following activity can be merely discussed theoretically, actually accomplished during the PowerPoint session or alternatively set as a homework assignment. First, the participants are asked to identify the “people assets” in their organization. Next, some of the risks to these people are listed. The organization’s reputation is described and then some of the risks to the organization’s goodwill assets identified. What events or crises could shatter the reputation that has been built over the years? Participants then put this all together by listing the priority risks they have decided to focus on from the lists previously compiled, leaving several lines of space between priorities. Then below each risk are listed some of the steps or actions the organization could take to minimize the likelihood of the risk materializing or reduce its negative effect on the organization should the risk materialize. The next steps in this process should be to involve others and keep in mind that additional expenditures may be necessary. The process requires common sense and sound planning. By keeping things simple there will be a better chance of success and with time this process should become more inclusive. A visual example of how this process is implemented in an organization is provided in Figure 2, which shows NOAA’s (National Oceanic and Atmospheric Administration) six-step process for risk management.

![Figure 2. NOAA Risk Management Six-Step Process](http://archive.rubicon-foundation.org)

**Applying Risk Management to Scientific Diving – Module Two**

Negligence is a legal construct that incorporates four components; the duty of care, a breach of that duty, causation, and damages. The duty of care is commonly referred to as the community or industry standard of care. In the scientific diving community an example would be the AAUS Standards. A breach of that duty would be a failure to comply with the standard. Causation relates to whether the acts or omissions were the cause of the loss or damage sustained. Damages relates to the harm caused (injury, death or property damage).

Negligence is not the same as carelessness. A person might exercise as much care as they are capable of yet still fall below the level of competence expected of them. It is the failure to use reasonable care, or conduct, that falls short of what a reasonably prudent person in our community would do to protect another person from foreseeable risks of harm. Note that this is not simply what a reasonably prudent person would do but rather, what a reasonably prudent person in our community would do (http://dictionary.law.com/Default.aspx?selected=1314).
How do Diving Officers avoid negligence? Follow the standards, exercise sound judgment, follow local practices, have appropriate safety equipment available, be prepared to respond to emergencies and certify only divers that meet requirements (Richardson, 2004).

The Costs
There are two types of costs of RM failures; direct and hidden. The direct costs include the obvious financial burdens of multi-million dollar insurance policies, legal representation and settlements. The hidden costs include the incurred personal toll. This can include the humiliation and stigma of being involved in an incident and the resulting impact on a person’s professional reputation. Media reports are frequently inaccurate and worded in layman’s terms. There is often an impact on both personal and professional relationships. A colleague that was previously considered a friend may testify against you. If a case is settled it is usually confidential or often goes unreported which means there is no opportunity for you to speak out. The time lost to the legal process (questions, depositions, reviewing documents) can take a considerable toll. The cost of replaying and reliving an incident for those involved can be horrifying as they continue to ask the “what if” questions of themselves. And finally, if you are found to not be culpable, who will remember or even be interested? The hidden costs of incidents can be onerous.

Tools and Practices
To assist in avoiding such costs, there are a number of available tools and practices. Written releases and waivers are one such tool, though some dive programs that are dealing with only employees will not need them because an employee cannot release an employer. Programs that have students, volunteers, interns or other non-employees that are not covered by worker’s compensation of the DSO’s employer may need to use such forms, as well as non-employee divers that are under any level of supervision or control by the DSO or employer. If a program hosts visiting divers under reciprocity, third party liability may apply, so the application of coverage must be established (e.g., which organization will provide medical coverage to the diver in the event of an incident?). If a release is used it must be written and administered correctly, which means that it must be written to apply to the unique activity and in accordance with state law so it should be drafted by an attorney in that state. To be administered correctly, the release must be based on informed consent. “Informed’ means that the signer has been provided an overview of the risks. “Consent” requires questions to be answered adequately, with time to think and decide provided in the absence of undue pressure or duress. Filling out a release in a dark vessel at five o’clock in the morning on the way to the dive site as the instructor tells you it is “just paperwork you need to sign” does not constitute consent and would not be enforceable.

Another tool is the AAUS medical release. Who is qualified and authorized to make decisions? The correct answer is both the medical practitioner and the DSO. While clearly the decision of a person’s medical fitness to dive is the realm of a medical practitioner, the DSO has a role in identifying potential medical issues to refer to a medical practitioner. If the DSO is aware of a recent illness or injury that might impact a diver’s medical fitness, the diver may be counseled to seek medical evaluation. In the event of a major illness or injury or a condition requiring hospital care, the diver is required to obtain medical evaluation (AAUS standards section 6.10). Another role of the DSO is to examine the medical release paperwork for errors and omissions. Is the form complete? Were required tests conducted and initialed? A very important element of this tool is that to comply with scientific diving standards, it must be signed by an MD (Medical Doctor) or a DO (Doctor of Osteopathy). The DSO must check the medical signatures before accepting the medical release as valid.

Waivers and medical releases are examples of legal forms that may be used in dive programs but there are a host of other documents that are commonly used to help organize, plan and document activities. Written schedules or databases that track equipment maintenance, training and frequency of medical clearance are powerful management tools. Written checklists for briefings and pre-dive
equipment checks are RM tools that not only provide a quick reminder to divers of the things they need to do. When actually used to check off tasks, they also document that these checks are being done. Dive plans are documents that guide divers through the planning process but are also designed to be used in an emergency by providing the information needed. It is important to have them present at the dive location.

Contingency planning is a practice that is a cornerstone of safe diving operations even if the contingency plan itself is never used. It is a discipline that is preventive by its nature. When contingencies are planned for the more likely it is to recognize hazards and plan to avoid them. Pre- and post-dive safety briefings and the protocol used for their conduct are some of the most critical preventive practices. It is also a practice that tends to erode over time as divers become comfortable and complacent. Pilots conduct preflight checklists before every flight regardless of how many times they fly the plane. Diving should be no different. Another practice common to dive operations is to reduce ratios or numbers of divers depending on conditions that can vary tremendously.

There are also tools and practices for equipment inspection and maintenance. Scheduling and performing “annual” servicing requires accurate and complete logs and records. Who performs the servicing and repairs and how often is it done? Diving equipment should be serviced by an authorized technician. How frequently equipment is tested and/or serviced varies with the equipment type, federal laws, state laws, the AAUS standards, frequency and type of use and other considerations. For example, some cylinders in heavy use may need visual inspections monthly rather than every 12 months (High and Gresham, 2009).

Fill station operations require a specific area of expertise and should be restricted to only current certified/authorized fill station operators. Air test results, a list of prohibited cylinders and fill station instructions should be posted at the fill station. Training for fill station operators must be provided every three years or whenever new regulations emerge. Maintaining records is also an important RM practice and should include compressor and fill station inspections and servicing as well as training and content (High and Gresham, 2009). Worthy of consideration is inviting an independent professional to inspect the fill station operations and provide a report to the organization.

A valuable tool available to dive programs is the practice of conducting program audits. There are several ways this can be done from using a standard self-audit form to inviting third party audits of the program or parts of the program (e.g. fill station operations). AAUS provides a Scientific Diving Program Compliance Review Checklist for its members to use that conforms to the minimal standards of AAUS as a simple self-audit tool. AAUS Organizational Member Program accreditation policy and procedures are now in place. The National Oceanic and Atmospheric Administration (NOAA) has some useful tools and documents that can be used in this fashion as well, including the NOAA Diving Program’s Unit Diving Inspection Checklist (www.ndc.noaa.gov).

Another critical RM practice is access to continuing education and professional development. While it is important to provide continuing education to all of the divers in an organization, it is critical that the DSO, as the person responsible for administration of the program, is current in all aspects. The law presumes that you are proficient. Do you have the knowledge, skills and abilities to continue to serve as a DSO, a dive leader and teacher? Are you comfortable in all areas needed to do your job? Standards, regulations and equipment are not static so these areas must be updated regularly. Skills are also not static and must be continuously upgraded and maintained. Attending conferences and symposia is certainly one option for professional development. This might include attending the annual AAUS symposium and Diving Officer meeting, Regional Diving Officer meetings, diving trade shows, commercial diving conferences or discipline-specific conferences (e.g., Benthic Ecology Meetings, Western Society of Naturalists, or the Association of Zoo and Aquaria annual conference). Reading publications and literature, participating in forums and news groups or simply picking up the phone and speaking with
colleagues are additional options. Another valuable educational technique is debriefing minor incidents or studying accident reports and reviewing these with the Dive Control Board (DCB). Taking or auditing a course or more specifically attending a DSO orientation or accreditation offered by AAUS are excellent professional development options. Publishing and presenting papers or teaching a course or assisting another instructor with a course can provide growth opportunities. A myriad of options exist for continuing education and professional development but most dive programs will require a broad set of skills so a multidisciplinary approach to maintaining DSO proficiency is recommended. In other words, sending a DSO to one workshop every few years will likely be inadequate. There are also required proficiencies that must be met, such as instructional requirements for currency, depth certifications, gas (mode), special environments, fill station operator training, equipment technician training and compressor maintenance certification to name a few. Again, the emphasis should be placed on assuring that the DSO is proficient and competent.

Finally, in terms of tools and practices, there is probably no more profound RM tool as developing a culture of safety. The diver’s attitude toward safety may have the most significant impact on safety. What is your attitude? What is the attitude of your divers, your supervisor and your organization? Safety may be the middle word in the title DSO but it is not the sole job of the DSO; it must be shared. Personal responsibility, responsibility toward the dive buddy, toward the dive team and toward the organization must be nurtured. The primary tool is communication. How safety issues and needs are communicated is part of this. The use of active listening skills and the responsiveness to safety communications are paramount.

Incident Management - Module Three

An incident is a terrible time to discover lack of preparedness to effectively handle a crisis. Should a serious diving incident occur right now what is the confidence level that all will respond correctly? Is effective response tested with drills and practice sessions? Is there an incident response plan?

The first step to dealing with an incident is to proactively develop an incident response plan. This should include written instructions on who must be contacted (chain of communications), how to organize and treat participants in an incident, rescue and recovery procedures, the preservation of equipment and counseling in preparation of an incident report. A spokesperson for the organization should be identified, as well as an attorney. There should be a prior clear understanding of post-incident roles, especially among the spokesperson, the attorney, the DSO, witnesses, responders and divers. The early interviews of witnesses should also be established.

In today’s lightning fast multi-media world the news of a diving incident will spread rapidly. It is not uncommon in metropolitan areas to have the media at the gate before the ambulance arrives. The incident response plan should include an information packet about scuba diving for use during the incident. A cover sheet should be included that lists newspaper and electronic media contacts with names and telephone numbers to send the information packet to. A similar electronic version that can be posted to the internet should also be available. Chat rooms, news groups and other social networks are hotbeds of misinformation. The organization should have a clear policy on how this will be managed.

The second step to dealing with an incident is to have a clear understanding of how to use a legal advisor during incident management. Communications are privileged so the details, process and questions for management of the incident can be freely communicated. However, the DSO should be clear that the attorney is the organization’s attorney, not the DSO’s attorney. The legal advisor can assist in gathering evidence and interviews and act as an analyst from a legal perspective.
The third step is to understand the role of the insurance company in an incident. First things first: it is critical to notify the insurance company within the required minimum time provided on the policy or take the risk that there will be no coverage. With respect to insurance companies, do not expect early participation or assistance and be aware that your agent/broker is not the person who will investigate the claim. Understand that the relationship often becomes adversarial and that the insurance company calls the shots on settlements. This means they may settle the claim even if no wrong was done. Just like the attorney, the insurance company is under contract with the organization not the DSO. This raises the question of who protects the DSO. Recreational instructor coverage will only apply to the direct teaching of courses, not other DSO duties. There currently exists no custom product available to the DSO. And finally, some institutions are “self insured” so the process may be even more difficult to navigate. Consider these issues in advance of an incident and be proactive in establishing an incident response plan. This is the same concept as “plan the dive and dive the plan.”

Even with a rigorous, relevant and updated incident management plan there may be many difficulties encountered managing an incident but there are a number of available resources including the AAUS, NOAA, UNOLS, AZA, the US Navy and others, including Diving Officers from other institutions that maybe able to act as advisors, investigators or simply as a second opinion or a sounding board. Tap into these resources as may be appropriate, or even list them in your response plan. A list of names, e-mail addresses and phone numbers of trusted advisors or colleagues that is placed in a convenient location can be a time saving and stress relieving feature of a well-managed crisis.

These are a few of the most common tools and practices that are available to organize, plan and document diving activities and many of them are required by the AAUS standards.

**Summary and Recommendations**

Three modules have been provided on the subject of RM in scientific diving programs that can be used as training or review tools at all levels of an organization. Depending on the audience and need, any one module or combination may be used and any may be tailored to the audience in terms of scope and delivery. Each module may also be used as a project template for developing an organization’s RM plan, or as an evaluation template to scrutinize an existing RM plan.

In a training application it is recommended that the modules be delivered in the order presented here to take advantage of the sequential learning approach that is built into the program. It is also recommended that the program be required reading for DSOs, DCB members and lead divers, though there are likely others in the organization that would benefit from this information.

It is worth repeating the mantra that following the standard reduces the risk. There are different environments, missions and priorities but the requirement of adhering to the standards is shared. How do we assure we are following the standards? The obvious answer is to become well educated on what the standards are and rigorously and frequently compare activities with them. Staying actively involved in AAUS is helpful to this end. Perhaps less obvious is the contribution to the RM position that is made by becoming or remaining an organizational member of AAUS. How does one know if the diving safety manual, diving control board and the Diving Safety Officer’s credentials are all compliant with AAUS standards? To become an organizational member of AAUS these elements of a diving safety program must be submitted to the standards committee for review and approval. Scrutiny of the program by the organization that sets the standards for scientific diving is quite simply the highest level of RM provided for those elements. We strongly recommend that all organizations claiming the scientific diving exemption become AAUS organizational members, attend annual meetings, and become actively involved in AAUS.
RM is a dynamic and daily process, comprised of a vast network of often simple decisions and activities fraught with the potential for complacency. A current, well-articulated RM plan super-imposed over this network provides a safety net for the diver, the dive program and the organization, protecting human life, property, goodwill and the missions of our valuable institutions.

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References


NOAA Diving Program’s Unit Diving Inspection Checklist (www.ndc.noaa.gov)


University of Hawaii Dive Planning Risk Assessment online at: www.hawaii.edu/ehso/diving/UHDivePlanApp2.pdf