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Communication Breakdown

Breaking down how scientists and engineers interact in Oceanography

In the field of Oceanography the collaboration between scientists and engineers is paramount. Miscommunications between the two can result in equipment failures and wasted ship time. They are two different cultures; both are specialists in their fields speaking seemingly different languages, rarely are they cross-trained in the other's discipline. Scientists are constantly salivating for more data and fast developing technologies can give it to them. Engineers work with scientists to develop and deploy instruments in harsh environments. However, ocean technology is often long strides behind the latest technologies. A better link between engineers and scientists could help to close the gap between newly developing technologies and what is used in the field.

Some scientists are willing to reach out and embrace new technologies while others are more reluctant. Sticking with the traditional approach is convenient, while developing new technologies is expensive and time consuming. There can be scientific reasons to continue using old methods, because switching to new methods would make it harder to compare to the historic data. However, the tried and true methods are sometimes crude and inefficient forcing some scientists to consider other possibilities. Often, scientists will try to repurpose existing technology to solve new problems.

The first place where miscommunications can arise is in the design-build stage. Often, the scientist will loosely describe to the engineer what it is they want and send the engineer to go build it. When the engineer returns with the product the scientist will realize that the engineer misinterpreted his instructions or that the engineer built what he said but it is still not quite right, so they scramble to make the necessary changes. Eric Olson, an oceanographer at the University of Washington, noticed that the experienced engineers have learned to ask lots of specific questions and return to the scientist with CAD models or simulations. This way they can be sure to agree on the desired product before anything is built.

The Regional Scale Nodes cabled observatory is a large-scale project that has massive technical challenges and seeks to support a wide range of scientific studies. Because it is so big, a multitude of specialized scientists worked with a team of engineers to come up with the requirements of the system. A formal systems engineering approach was taken because of the vastness of the. The entire project is centered around 10 broad scientific questions ranging from seismology to physical oceanography to chemical oceanography and so on. The questions were organized in a series of large matrices that broke the large questions down to smaller questions, and eventually to the different instruments that were needed and where they should go. From there, the engineering requirements could be determined and the engineers started to design the system. These matrices effectively converted the scientific questions into engineering problems. A lot of time and energy was put into these spreadsheets to make sure nothing was overlooked. Review meetings were common where teams of scientists and engineers discussed progress and ideas to make sure the engineering was adequately supporting the science.

Spreadsheets and review meetings are an effective way to formulate the engineering requirements of complicated systems, and could easily be adopted for smaller projects.

Once on the boat and deploying the instruments new challenges emerge. Weather and equipment failures often quickly overturn a cruise plan sending all the careful planning to shambles. This means many decisions must be made on the spot. Often when plans change quickly it is easy for details to get lost. Ultimately, the chief scientist is in charge of all the science operations; he/she usually has an excellent broad understanding of the overall project but may not know all the specifics. The chief scientist relies on all the specialized personnel including engineers, scientists and crew to advise with their respective specialties. The chief scientist often organizes engineering/science meetings to bring everyone together and discuss any issues that come up. This allows engineers or scientists to brief everyone on their instrument, what it does and why. When everyone better understands the instruments and the deployment process, fewer mistakes will occur.

The most complicated deployments involve Remotely Operated Vehicles (ROVs). This adds another team of engineers who do not start with an intimate knowledge of the project but are essential in getting it done. To bridge this gap the ROV team demands a dive plan before their vehicle enters the water. This allows them to make sure everything needed for the mission is on the vehicle and provides a list of tasks to follow once on site. It is also a tool for the science team that forces them to organize everything that needs to be done during the dive. Every engineer or scientist that needs something done on the seafloor talks to the dive planner, who then compiles and schedules all the tasks for the dive plan. Once at the site the ROV team reserves a chair called the “hot seat” where a science party member can give instructions to the pilot. This is also useful because there is only one person talking to the pilot which helps keep the control room in order. If there is some sort of problem the room converges and everyone discusses the best way to proceed.

Cross training scientists and engineers is an effective way to improve their communication with each other. An investigator trained both in science and engineering may see creative ways to answer challenging questions with new technologies. Some cross training occurs in universities, specifically in Ocean Engineering. An Ocean Engineering curriculum has both science and engineering aspects. The students will take many core science and Oceanography classes as well as all their engineering classes. Dana Manalang got her degree in Ocean Engineering after switching from oceanography. She now holds a position at the Applied Physics Lab (APL) at the University of Washington where she is the expert in sensors and instrumentation acting as a link between scientists and engineers. University classes are not the only option for learning engineering or science. Occasionally, projects with many people will hold seminars related to the science or engineering. At the APL there are coffee breaks 3 times a week which allow engineers and scientists to mingle and discuss their various projects. This is an informal way for employees to learn about each other’s different projects and get exposed to new technologies. It also provides an environment for people to casually bounce ideas off each other for new projects without the pressure of a formal meeting.

When looking at how scientists and engineers communicate a consideration must be given to the human condition. This whole article is looking at stereotypes which are often broken. John Delaney believes that “if you have a good enough idea people will jump onboard.” The cabled observatory idea was created at a bar during a conversation Delaney and Alan Chane. Delaney posed the problem that diving in a submersible did not give you enough time to on the bottom to see anything change. Chane mentioned the new technology of fiber optic cable which makes it possible to send high bandwidth communication over long distances. Collaborations like these break any possible mold and are simply the result of two people who hit it off and have big ideas.

Everyone gave a little chuckle when I mentioned that I was researching how scientists and engineers interact. They both approach problems in a systematic way but the problems they look at are hugely different and so are the results. Each being experts in their own field, they do not always have the background to understand what the other is doing. This lack of understanding also makes communication difficult especially with so much specialized vocabulary and concepts. As engineers and scientists advance the ways they interact better technologies will in adopted in the scientific fields.