Almost all (99%) international data is transmitted by around 265 subsea cable systems connecting the world. The total length of subsea cables exceeds 1.6 million kilometres, and they can be found as deep as 8,000m. The cables, which can cost hundreds of millions of dollars, must generally be run across flat surfaces of the ocean floor, taking care to avoid coral reefs, wrecks, environmentally and politically sensitive areas and general geological obstructions. Diameters are generally no thicker than an average garden hose. Cable laying is an expensive operation and the cost is a function of the total length of cable, water depths and required protection and resulting cable types. This presents various planning challenges that surveying can help to address, as this article explains.

Prior to the installer laying the cable on the seabed, the survey contractor should provide the installer with the integrated geophysical and geotechnical data required to finalize the installation plan and procedures. Before the survey can start, a comprehensive desktop study is required to address the optimal route, the survey methodology and schedule of work. The primary study comprises the topography and type of seabed vs optimal or shortest routing. Based on the designed cable survey route, logistics and environmental parameters a route survey scope of work is prepared which is the basis of the survey plan.

Nearshore or Offshore
Since subsea cables are laid shore to shore there will be nearshore, shallow (<1500 m) and deep water (>1500 m) survey requirements as part of the scope of work. The shallow-water survey covers typically a 500m – 1000m survey corridor where cable burial is proposed and which should be surveyed using a different range of sensors such as multibeam echo sounder, sub-bottom profiler, sidescan sonar and magnetometer. There are also nearshore sections (from 0 to approximately 3m) that need to be surveyed by divers that collect video footage and probe sediment thickness where survey vessels cannot operate. The survey sensors used in deep water are like those for nearshore surveys but with different specifications. A burial assessment survey using CPTs and coring is also required for ground-truthing the geophysical interpretation and finalization of the Burial Assessment Survey. In deep water beyond the proposed water depth for burial a single line of multibeam echo sounder data is collected to full ocean depth providing survey swaths of 3 x water depth up to 10 kilometres wide.

Besides the chosen survey instruments and techniques, timing is a third factor and should address the optimization of the survey plan as well as contingency plans to avoid any operations downtime, especially when the survey vessel is required to work in very remote areas. Survey timing is critical in areas affected by seasonal weather patterns, i.e. monsoons in Asia, hurricanes in the Caribbean, cyclones in South Indian Ocean, etc. and significant savings can be achieved by surveying during the ‘right’ time of the year. To achieve an optimum plan, particularly for surveying the offshore and deepwater section, an accurate segmentation of the survey disciplines based on the weather and environmental parameters has to be conducted and scheduled in the Plan of Work.

Shallow-water Considerations

In addition to the weather and tidal behaviour of the coastal waters, the topography of the seabed sometimes makes the nearshore survey challenging. Achieving a full multibeam coverage of the shallow-water section results in a very tight line spacing design. A 20% overlap requires modification from 50m line spacing at 9m water depth to 25m line spacing at 5m water depth. The multibeam survey is not efficient in depths less than 5 metres as shown in Figure 2. Another challenge is observed when the coastal area has an immediate slope change and a very steep and narrow continental shelf, such as in remote pacific islands. In these cases, the survey cannot be undertaken in both directions and the equipment needs to be towed from nearshore to offshore or downslope to avoid collision with a rapidly shoaling seabed. This will result in additional transits and consequently increase in survey time (Figure 3).

Deepwater Considerations

As water depths increase there are many parameters to take into consideration, for example, underwater currents affecting survey positional accuracy when operating deep tow sensors. This is critical for subsea object detection and positioning. Also
are made available, the quicker they can be used to manufacture the cable. However, telemetry of data to shore is expensive.

Sent to the manufacturing factory during the survey. Cable engineering is a time-sensitive process, the faster the survey results are real-time on board and are used for analysis of the proposed survey route. The data will be used to provide an on-board post survey route (for installation) and the cable and installation parameters will be engineered at this stage. Design criteria can be

Every cable route survey deals with multi-gigabytes of raw data on a daily basis. The survey results and reports are generated in real-time on board and are used for analysis of the proposed survey route. The data will be used to provide an on-board post survey route (for installation) and the cable and installation parameters will be engineered at this stage. Design criteria can be sent to the manufacturing factory during the survey. Cable engineering is a time-sensitive process, the faster the survey results are made available, the quicker they can be used to manufacture the cable. However, telemetry of data to shore is expensive.
Online real-time monitoring is critical on board the survey vessel to reduce the potential of having to transit back to problematic areas to conduct re-route or deviation surveys.

**Conclusion**

Cable route surveys present different and sometimes unique challenges on a project by project basis. A high-quality desktop study is required prior to any planning and operations to best prepare for any eventuality. A properly defined scope of work is a vital part of the process which helps to select the most appropriate survey tools for expected survey and cable route conditions. Best survey practice consistent with the acquisition of high-quality data, with an ability to modify a survey plan in the field are vital. Onboard processing and data presentation are key for timely decision-making and product delivery for manufacture. If field works are executed during optimum weather seasons, the costs of surveys can be reduced significantly. However, financial pressures may dictate that surveys be conducted in unfavourable conditions in favour of a more successful installation.

https://www.hydro-international.com/content/article/subsea-cable-route-surveying