

**Research Note**

**Underwater Search and Recovery: A reference to develop a regulatory framework for the Indian Ocean Region**

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# INTRODUCTION AND MOTIVATION

The Indian Ocean Region (IOR) is strategically gaining substantial relevance, resulting in massive maritime build-up both militarily and otherwise. The economic aspect of it’s importance is highlighted by the fact that the IOR is the most critical area globally, in terms of international energy and commerce that crosses these waters [1]. Container traffic through the region’s ports has increased fourfold from 46 million TEUs in 2000 to 166 million TEUs in 2017 [2]. Over 95% of our trade happens through the maritime router. The increasing maritime build-up, exposes us to vulnerabilities related to accidents and losses at sea of both human and high value assets. Underwater Search & Recovery (UWSAR), is becoming critical, thus effective & efficient capability and capacity building is inescapable.

The IOR with its tropical littoral waters further presents very unique challenges in terms of sub-optimal performance of the sonars deployed for acoustic surveys. The random fluctuations in the acoustic propagation characteristics in the underwater medium is the major contributor to the sub-optimal performance. Import of underwater hardware from the west has not helped in the absence of indigenous efforts towards customizing the algorithms to the local ground realities. Massive field experiments involving Shallow Waters Acoustic Measurements (SWAMs), preceded with Modelling & Simulation (M&S) efforts to map the underwater characteristics are necessary to enhance the sonar performance. The developing nation status with pre-modern governance structure limits the possibility of allocation of such massive resources to R&D for futuristic strategic vision.

Under this project the technological requirements and challenges to complete every step of UWSAR operations will be discussed and the work of organizations involved in each step will be discussed in detail. Case study of some recent operations has been done to help finalize search and rescue vehicles and infrastructure in the IOR. Also a detailed study of the present form of organizational structure is done which helps us to understand how the SAR bodies co-ordinate and co – operate to complete the operation successfully at the times of crisis.

This aim of this project is to act as a reference to help create a regulatory framework for these operations in the IOR and to help India head SAR operations for almost 40 countries present in the IOR.

# BASIC STEPS INVOLVED IN UWSAR

**Step-1 Marking of the last known position of the platform.** This is a very critical step as the entire start of the UWSAR begins from here. The oceanographic parameters at the marked position and the continuous recording of these parameters from the time of the incident become a very critical input.

**Step-2 Modelling and Simulation (M&S)** The movement of the platform from the last known position till the actual search operation is initiated and beyond becomes important to plan the entire search operation. The platform has to be monitored till it settles down in a stable position in its final resting location. This monitoring is undertaken using M&S that gets inputs on the oceanographic parameters to estimate the movement of the platform from the last known position. The model provides the framework and based on the platform and oceanographic parameters fed to the model, extensive simulation is undertaken to generate possible movement of the platform.

**Step-3 Ground Information** The inputs on the underwater features is extremely critical to plan the survey (search operation). Availability of inputs on the bathymetry, sediment type and macro underwater features in the search area could be a leg-up, otherwise such survey may have to be undertaken as a pre-requisite. Acoustic surveys have their own challenges, particularly in the tropical littoral waters.

**Step-4 Finalization of the Search Infrastructure** The inputs from step-1, 2 & 3, will determine the search infrastructure/tools. The sensors (type of sonars in terms of frequency as well as spatial coverage), platform for mounting the sensors (surface using ships or underwater using manned/unmanned platforms), data processing requirements (based on search area and the volume of data recorded) and more.

**Step-5 Mobilization of the Search Operation** The actual mobilization of the search operation will be governed by the earlier steps. The tropical littoral condition, proximity to the search area, availability of the search resources and more will determine the entire search pattern and the corresponding logistics. The M&S will support optimization of the entire effort based on precise inputs of the local site specific conditions as discussed in the earlier steps.

**Step-6 Salvage/Recovery Operation** Once the platform is located, the salvage/recovery is again a completely different operation and highly specialized. Based on the platform to be salvaged/recovered, the requirement of infrastructure and the tools will be finalized. Underwater Salvage is a highly specialized exercise and requires unique equipment’s that are available with very few countries or organizations globally. Thus, right at the beginning, these factors need to be ascertained.

# CHALLENGES AND OPPORTUNITIES

India is a signatory of the International Convention of Maritime Search and Rescue (SAR), 1979 ratified in May 2001. India’s obligations under the convention include formation of national legislation for implementation, Establishment of SAR plan as per IAMSAR manual [4], establishment of facilities and competent manpower [6]. The convention requires parties to co-ordinate search and rescue organizations, and, where necessary, search and rescue operations with those of neighbouring States. The Chapter states that unless otherwise agreed between the States concerned, a Party should authorize, subject to applicable national laws, rules and regulations, immediate entry into or over its territorial sea or territory for rescue units of other Parties solely for the purpose of search and rescue. [5]

In order to provide expeditious and effective SAR services as per the National Search and Rescue Plan, it’s important to meet the domestic and international contingencies in Indian SRR. It’s important to support life saving provisions of International Conventions on Maritime Search and Rescue of IMO and convention on International Civil Aviation of ICAO and other International/Regional agreements to which India is a signatory. Our objective must be to achieve humanitarian, national and international SAR related obligations in Indian SRR by thorough coordination. [3]

It is also noteworthy that there are certain limitations that needs to be overcome to make every step of the SAR process more efficient. Finding the last known position of the air craft is an example. **Primary radar**is based on the earliest form of radar developed in the 1930s, detects and measures the approximate position of aircraft using reflected radio signals. It does this whether or not the subject wants to be tracked. **Secondary radar,** which relies on targets being equipped with a transponder, also requests additional information from the aircraft - such as its identity and altitude. All commercial aircraft are equipped with transponders (an abbreviation of "transmitter responder"), which automatically transmit a unique four-digit code when they receive a radio signal sent by radar. **The Malaysia Airlines flight MH370 disappeared from air traffic control screens when its transponder signal stopped [7].** Flight tracking can also be done through the ADB-S system. ADS-B is an air traffic surveillance technology that relies on aircraft broadcasting their identity, a precise Global Positioning System (GPS) position and other information derived from on-board systems. The data is broadcast every half a second from the aircraft, and is being used by Air Traffic Controllers (ATCs) to identify and separate aircraft in real time. Space-based ADS-B extends the same ADS-B technology currently received on ground-based receivers to space. Though more efficient and accurate than radar systems, ADB-S isn’t used conventionally owing to lack of infrastructure and high cost of operation.

Location of some other vessels can be done using the conventional AIS data. Automatic identification systems (AIS) are designed to be capable of providing information about the ship to other ships and to coastal authorities automatically. However there are certain regulation for carriage of AIS that must be followed [9].

Bathymetric surveying is an important part of the underwater search and rescue process. No ocean-wide map of the Indian Ocean has been produced since the 2003 map based on the work of Dr. Bob Fisher and D.r Andrew Goodwillie. No ocean-wide map has ever been produced using multibeam (as opposed to single beam) echosounders. No ocean-wide map has ever been produced incorporating long-wavelength information from satellite altimetry. Yet some of these data exist for the area. This means that the Indian Ocean is not as well mapped as it can be and should be.

# SOLUTIONS AND WAY AHEAD

SAR operations in our waters are held as per the SAR conventions of 1979 in the following way - The division of SAR responsibility into geographic areas to provide centralized control, coordination, and effective use of all available SAR facilities, including SAR Coordinators (SCs), Rescue Coordination Centers (RCCs), Rescue Sub Centers (RSCs), SAR Mission Coordinators (SMCs), On Scene Commanders (OSCs) and Search and Rescue Units (SRUs). Above all the National SAR board chaired by the DG of coast guard co-ordinate and formulate National SAR plan including its review and updating. [3]

The Indian Coast Guard is responsible for executing/ coordinating Search and Rescue missions in the Indian Maritime Search and Rescue Region (ISSR). Director General of the Indian Coast Guard is the National Maritime Search and Rescue Authority (NMSARCA). Under NMSARCA the ISSR is divided into three areas with Maritime Rescue Coordination Centres (MRCCs) at Mumbai, Chennai and Port Blair. There are 10 Maritime Rescue Sub Centres (MRSCs) and 3 of Maritime Rescue Sub Sub Centres (MRSSCs) that operate under different MRCCs. The multi mission Indian Coast Guard stations located along the coast, deploy state of art ships and aircraft to provide search and rescue coverage in ISSR. The SRR of neighbouring countries namely Pakistan, Maldives, Sri Lanka, Seychelles, Mauritius, Indonesia, Malaysia, Myanmar and Bangladesh share the boundary with Indian SRR. These SRRs are established in cooperation with the neighbouring nations which are internationally recognised and described in the pertinent documents of IMO and Admiralty List of Radio Signals (ALRS) Vol 5. [10]

The Airports Authority of India (AAI) provide Communications, Navigations and Surveillance of airplanes for Air Traffic Management. They have the database of radar systems tracking data that can be used to trace last known positions of distressed airplanes and hence Memorandum of Understanding with them is essential.[11]

The satellite-tracking system operated by a trio of companies: Aireon, SITAONAIR, and FlightAware. It uses a constellation of 72 communication satellites operated by US firm Iridium (whose main business is selling satellite phones connected to its network). The flights will be tracked using an industry-wide standard known as “automatic dependent surveillance – broadcast” or ADS-B, which usually shares data on flight location via ground-based receivers. Using satellites will offer more comprehensive coverage in remote regions. [12]

GEBCO has recognised the importance of assembling the highest possible resolution bathymetric dataset for any given region. A number of regional projects are underway that concentrate on identifying, sourcing and collating the best available data for a given area. The Nippon Foundation / GEBCO Indian Ocean Bathymetric Compilation (IOBC) project is one of the recognized GEBCO regional projects. Others include the International Bathymetric Chart of the Arctic Ocean (IBCAO) at  [ngdc.noaa.gov/mgg/bathymetry/arctic/](http://www.ngdc.noaa.gov/mgg/bathymetry/arctic/) and the International Bathymetric Chart of the Southern Ocean (IBCSO) at [ibcso.org/](http://www.ibcso.org/).[13]

A study of search vehicles and rescue infrastructure used in the recent search and rescue operations like the MH370 case of 2014 and AF 477 of 2009 is essential to finalize the same for operations in the Indian Ocean Region. Also important is a through study of the KUSK incident to form a organization structure and regulatory framework of recovery of nuclear submarines and conducting nuclear surveys. [14,15,16]

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