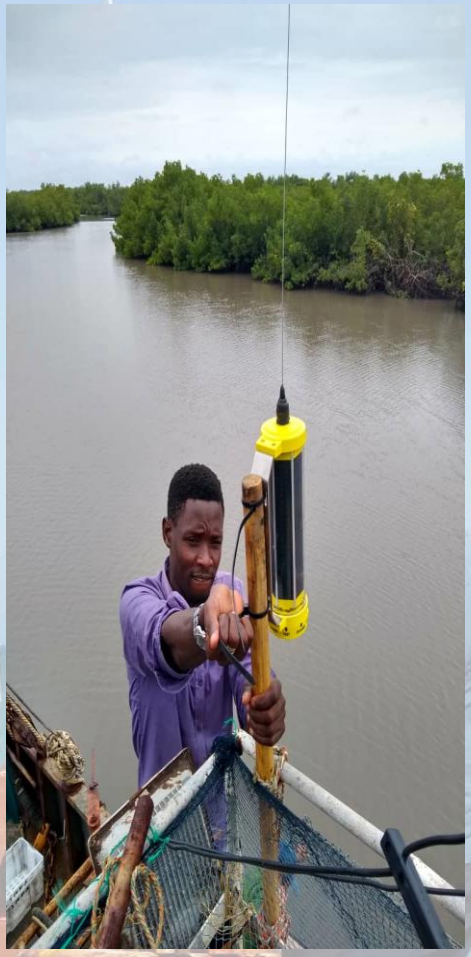

‘SOUTH AFRICA SAFETY INITIATIVE FOR SMALL VESSELS’ OPERATIONAL TAKE-UP (OASIS-TU)

UK Space Agency International Partnership Programme (IPP) Case Study

exactEarth® Europe

UK SPACE AGENCY

SAMSA SOUTH AFRICAN MARITIME SAFETY AUTHORITY

SEA RESCUE NSRI SOUTH AFRICA

CENTRE DE FUSION D'INFORMATIONS MARITIMES — MARITIME INFORMATION FUSION CENTER — MIFC

Marine Data Solutions

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GCRF Global Challenges Research Fund

Executive Summary

Each year, thousands of mariners in small vessels lose their lives at sea and billions of dollars are lost to illegal fishing and resource smuggling, both activities also often involving small boats. Accordingly, two significant challenges faced by modern coastal states are the need to ensure small vessel maritime safety in their areas of interest, as well as the need to be able to monitor and manage small vessel maritime activities within their EEZ and beyond. These dual goals have led to a demand for an affordable, wide-area, large-population small vessel tracking solution which also incorporates internationally recognised maritime safety capabilities.

It was these dual demands that induced exactEarth to develop its AIS-based 'exactTrax' solution to meet this important global requirement. exactTrax allows specially modified AIS Class B devices to be tracked reliably via satellite. As such, it combines all the key attributes and global standards of AIS related to vessel safety, together with the ability to track small vessels regardless of their location – in-shore, off-shore or on the high-seas.

With this background, the UK Space Agency's 'International Partnership Programme' (IPP[1]) support for exactEarth Europe's OASIS-TU project has been instrumental in:

- implementing exactTrax as an operational service in South Africa. The project is being delivered through our South African partners, the South African Maritime Safety Authority (SAMSA) and the National Sea Rescue Institute (NSRI). Benefits include a reduction in small vessel-related deaths at sea (South Africa has some of the most treacherous sea conditions in the world) and a reduction in Search and Rescue (SaR) costs (millions of Rand are spent every year by SAMSA and the NSRI on small vessel rescues).
- supporting the development of a new exactTrax transponder by Stone Three Venture Technology, a South African company, for subsequent, and very successful service trials in Madagascar. These involved five Malagasy government agencies: CFIM, APMF, COFONA, CSP and ARTEC, and fifty small boat operators in three regions of the country. As the trials were so successful, all the stakeholders are now looking for further capital funding for an operational deployment to reach 1,000 small boat operators in Madagascar.
- allowing exactEarth Europe to promote exactTrax, via in-country small-scale service trials, in a further five SADC maritime nations and two countries in West Africa. Local small boat monitoring requirements across these include safety of life at sea and small-scale fisheries management.

This means to date that the OASIS-TU project has led to partnerships being formed with nineteen African government agencies and companies, and over two hundred local people have been trained in satellite AIS.

In summary, in addition to the operational deployment in South Africa, this project is also performing the essential 'seed' activities in a large number of African countries related to the education, trialing and deployment of an innovative low-cost satellite solution which provides the capability to combat the multi-billion-dollar illegal fishing problem and to improve the safety and economic livelihood for the fisherman. These are issues which are not only important to the countries themselves but are also of high importance to the global community as we look to manage global fishing stocks and third world economic stability. This project would not have been feasible without the IPP funding and is an excellent example of the strategic value and importance of government funding in the adoption of high-potential innovative solutions to significant international social and resource management issues.

[1] Funded from the Department for Business, Energy and Industrial Strategy's 'Global Challenges Research Fund' (GCRF).

Contents

Project Background

World-wide, small fishing vessels and small commercial ships/work boats account for many of the accidents occurring at sea, and drowning death rates are highest in the WHO African Region. In the event of a small boat accident, the biggest challenge for regional or national safety authorities is knowing where to search as typically these boats lack any navigational, safety, communications or tracking equipment. Moreover, small fishing boats often operate outside coastal waters, or in places where coastal tracking systems / cell phone networks are not available.

South African waters are notorious for stormy weather, making it one of the most treacherous sea areas in the world. SAMSA and the NSRI typically annually carry out tens of SaR missions involving incidents with small boats - incurring costs to SAMSA and the NSRI of several million Rand a year.

Other SADC and West African countries share the same concerns with respect to safety of life as South Africa. Additionally, many African governments are also interested in tracking small vessels from a fisheries management and maritime surveillance/security point of view.

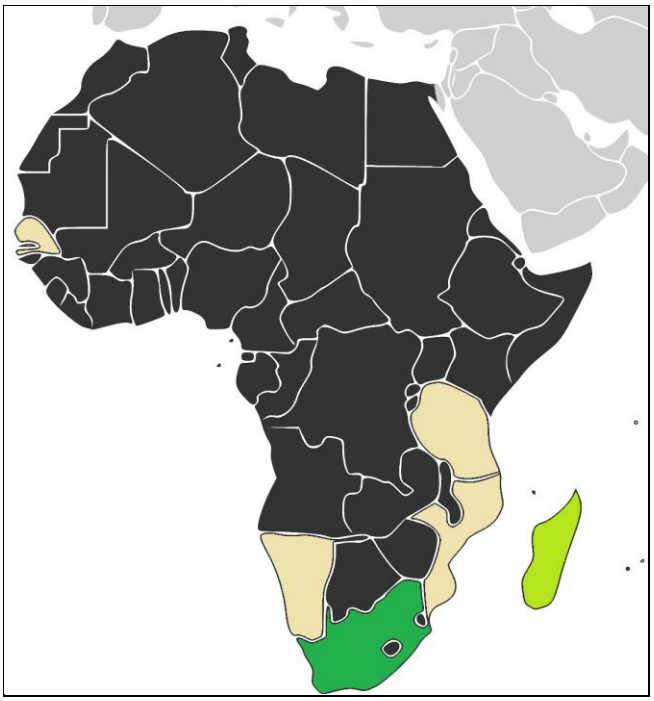
The collective challenge, therefore, is to provide a cost-effective means of tracking small boats, such that in the event of an incident at sea, either the crew can send an alert, or if this is not possible and the boat does not return when expected, the authorities know its last position and where to search more effectively.

Primary Sector: Maritime Safety, Fisheries Management and Maritime Security.

UN Sustainable Development Goals:

Why and How Space Can Help: Small boats may operate far from shore, which makes tracking them with terrestrial systems difficult for national authorities. Even tracking small boats that operate in-shore will not be practical unless coastal tracking systems / services are in place. However, appropriate satellite systems can support tracking of boats regardless of their location – inshore, offshore, or on the high-seas.

Countries of Focus: South Africa (main project – operational deployment), Madagascar (local technology development / trials), and Namibia, Mozambique, Tanzania, Seychelles, Mauritius, Gambia and Senegal (concept trials).



Project Partners

The OASIS-TU project involves a consortium of international commercial and institutional partners, and is divided into three main components:

- Operational service deployment in South Africa
- Local (South African) technology development and subsequent trials in Madagascar
- Concept trials in Namibia, Mozambique, Zanzibar, Mauritius, Seychelles, Senegal and the Gambia.

Funding Agency

UK SPACE AGENCY — Executive Agency responsible for strategic decisions on the UK civil space programme.

Lead Partner

exactEarth® Europe — UK Satellite AIS data and services company.

South Africa – Operational Deployment

SAMSA SOUTH AFRICAN MARITIME SAFETY AUTHORITY — Ministry of Transport 'South African Maritime Safety Authority' – tasked with ensuring safety of life and property at sea.

Marinel Data Solutions — South African maritime systems and services company.

SEA RESCUE SOUTH AFRICA — South African voluntary non-profit organization tasked with saving lives through drowning prevention and the provision of rescue and emergency evacuation services.

Other partners involved include **Ovenstone Agencies** (South Africa) and **Tristan da Cunha's Communications Department**.

Madagascar – Technology Development / Trials

StoneThree Venture Technology — South African maritime hardware and software solutions company.

Madagascar 'Centre de Fusion d'Informations Maritimes' (CFIM).

IBONIA — Malagasy Information Technology company.

Other local stakeholders involved include: the **APMF** (l'Agence Portuaire, Maritime et Fluviale); **ARTEC** (L'Autorité de Régulation des Technologies de Communication); **COFONA** (Le Commandement des Forces Navales); and **CSP** (Centre de Surveillance des Pêches).

Extension – Concept Trials

Mauritius Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping.

Gambia Ministry of Fisheries.

ZAFICO — Zanzibar Fisheries Company (ZAFICO), established by the Government of Zanzibar.

Mozambique Ministry of Sea, Inland Waters and Fisheries - National Fisheries Administration.

Ministry of Works and Transport — Namibia Ministry of Works and Transport – Directorate of Maritime Affairs.

Seychelles Maritime Safety Agency.

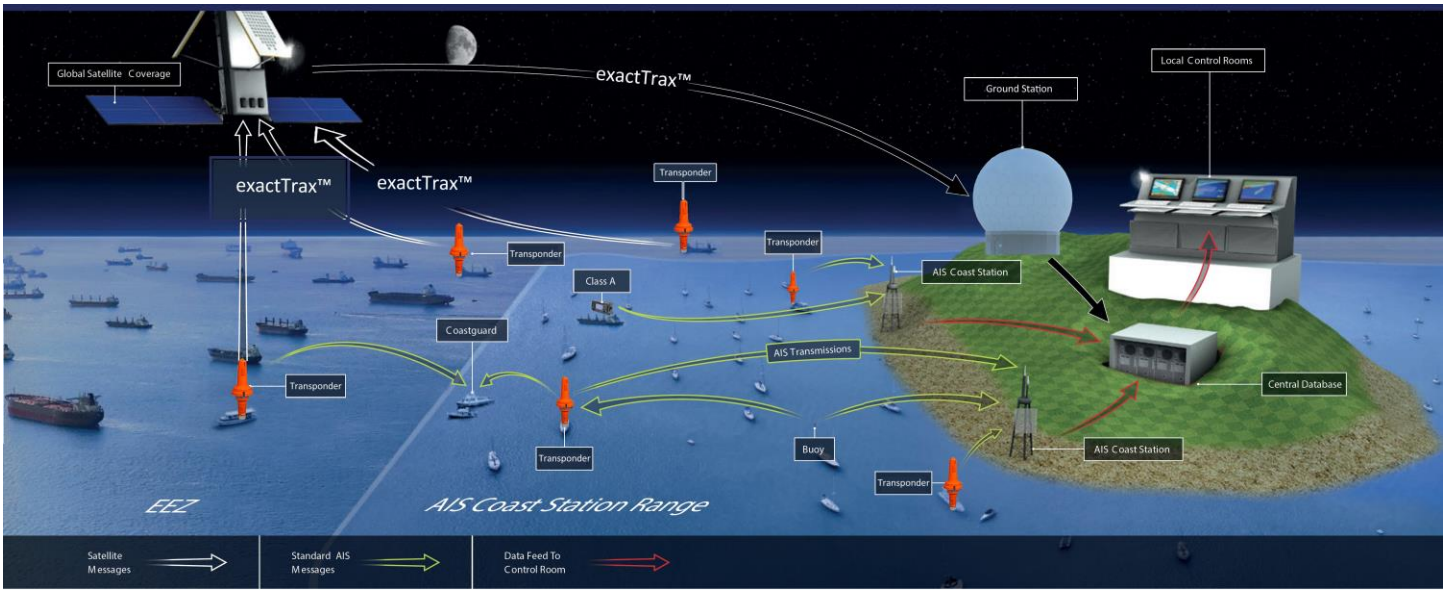
Senegal Ministry of Fisheries and Maritime Economy.

Solution Overview

'Automatic Identification System' (AIS) is an international standard mandated by the IMO for carriage on all ships over 300 gross tons operating in international waters. AIS is primarily a safety / collision avoidance system – ships carrying AIS VHF radio transceivers regularly transmit, using a set of standard messages, their position and other data for reception by neighbouring AIS-equipped ships and coastal AIS receivers. As such, AIS is a 'line of sight' system, and when a ship is more than ~30-40 nautical miles away from a neighbour or shore station, its AIS transmissions are no longer detectable. However, from 2009 it has been possible to detect AIS transmissions by satellite, which means that with a suitable satellite network, ships are now 'viewable' wherever they are located in the world – inshore or mid-ocean. AIS also supports the broadcast of a standard safety message if there is an incident on-board; again, these messages can be picked up by local AIS-equipped ships, coastal receivers and AIS satellites.

Full Class A or Class B AIS transceivers can be expensive, require on-board power, need to be installed in a waterproof environment on-board, require the additional installation of separate VHF and GPS antennas, and to be connected to a ship's navigation systems. This means that their use on very small fishing or work boats is often not practical. However, a number of AIS transceiver manufacturers have developed a range of battery powered 'all-in-one' AIS transponders (i.e. transmit only devices) that can easily be deployed on any boat, even very simple wooden fishing boats such as Pirogues and Canoes. As well as transmitting standard AIS position messages to support collision-avoidance with bigger ships, these devices also have an 'SOS' button that when activated by the crew, will also transmit a standard AIS safety message.

However, whilst these transponders make the use of AIS practical for small boats, to conserve battery life the devices normally transmit at much lower power than their full Class A or Class B counterparts, and this can make them difficult to detect by satellite. As many countries around the world do not have comprehensive coastal AIS systems, and many small boats operate a long way from shore anyway, satellite AIS is an important service with respect to real-time tracking and SOS detection. To that end, in partnership with several AIS transponder manufacturers, exactEarth has developed its 'exactTrax' advanced signal processing techniques that effectively 'boost' the power of a transponder's transmission – making it much easier to detect in space.



Solution Deployment – South Africa

Under the management of SAMSA and via its regional offices, 1,000 exactTrax-enabled em-trak I100 AIS Identifier transponders procured under the project, are being delivered to small boat owners and operators along the South African coast, with an emphasis on small boats operating in the Western and Southern Cape (the weather and sea temperatures here can be particularly poor). A further 200 transponders are being kept by SAMSA as spares and they have also provided 300 to neighbouring SADC countries for concept trials.

To encourage use of the devices, SAMSA has published its Marine Notice No. 27 of 2018 "SAMSA Recommendation – use of an Identifier Unit for Maritime Safety".

Deployments

SAMSA's main focus is to deploy the transponders on small non-commercial and commercial fishing boats, although they are also targeting recreational small boat users too. Illustrated is an 8 metre 'chucky' fishing boat operating out of Arniston. These boats typically have a crew of ten and operate at night, fifteen miles off shore line-fishing.

Detection

exactEarth operates a constellation in excess of sixty AIS satellites, which means a satellite's revisit time over South Africa is a few minutes. Additionally, the data latency for the majority of these satellites is less than a minute.

Data Monitoring

Near-real time AIS tracking data and any broadcast SOS safety messages from the transponders are fed by exactEarth into SAMSA's Cape Town-based 'Maritime Rescue Co-ordination Centre' (MRCC) systems. Additionally, the data is made available to the NSRI via exactEarth's ShipView web-based data display tool.

Other Services

Latest boat position data can also be viewed by owners / operators / families via an SMS text service for users of GSM-only phones, and also via an Android Smartphone 'app'.

Additionally, the NSRI have been equipped with mobile AIS receivers/display tablets to assist in detecting boats from the coast.

Solution Deployment – Madagascar

exactTrax is a RF technology that can be integrated into any AIS transceiver or transponder. A second part of the OASIS-TU project therefore looked at the development of a new AIS Class B transponder by the South African company 'Stone Three Venture Technology'. Their idea was to create a product that in the first instance was particularly applicable to the African market – both from a cost point of view, and an ease of deployment / operational perspective too.

Stone Three therefore developed the 'AngelFish' exactTrax-enabled Class B AIS transponder in 2017, which has now been trialed extensively in Madagascar during 2018. The unique selling points of the AngelFish transponder are its integral solar panels, allowing its internal battery to be charged continuously and in doing so, it supports a much-desired 'fix and forget' deployment strategy.

Madagascar is extremely interested in small boat tracking not only from a safety of life point of view, but also with respect to fisheries management and maritime security and surveillance – the latter because the country suffers from large-scale rose wood, drug and people smuggling often involving small vessels. The Malagasy government has seen AIS as a tool to help with these issues (and as such had published in 2017 an AIS carriage regulation for all small motorised vessels) and are interested in finding cost- and operationally-effective AIS technologies suitable for use on small boats.

The 'AngelFish' Transponder

Stone Three's 'AngelFish' solar-powered Class B AIS transponder operates at 2W ERP. It transmits both exactTrax and standard Class B AIS messages. GPS is integral, and the transponder is supplied with an external 40cm whip VHF antenna. When manually activated, an SOS button broadcasts AIS Message 14 safety messages.

Small Vessels in Madagascar

There are around 1,000 small motorised local cargo and fishing boats operating in Malagasy waters, and up to ten thousand pirogues.

Local Stakeholder Support

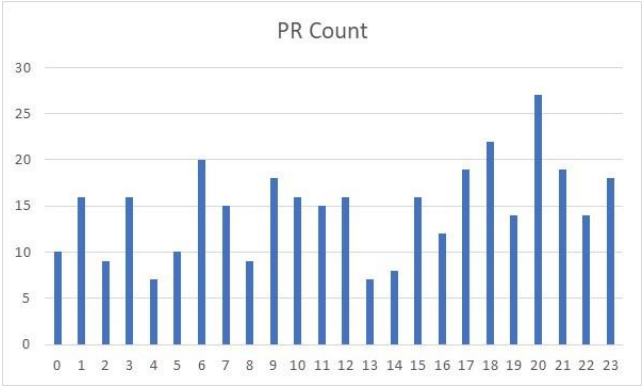
In-country trials support was led by the CFIM, with support from Ibonia, the APMF, COFONA, CSP and ARTEC.

exactTrax Trials

'AngelFish' transponders were installed on fifty boats, mostly motorised fishing and cargo boats operating out of Nosy Be, Toamasina and Sainte Marie. Transmitted data was made available to local stakeholders via exactEarth's ShipView system.

Trials Results

The trials concluded in October 2018 and have been judged a great success by all the stakeholders. exactTrax satellite detection rates were excellent, with, on average, a minimum of five position reports per hour, every hour of the day; the mean number being ten per hour.



Solution Deployment – Extension Partners

Based on interest in the project expressed by several maritime SADC countries, as an extension to the main project, three hundred exactTrax-enabled em-trak I100 AIS Identifier transponders and exactTrax data services have been supplied by SAMSA across seven other African countries for concept trials.

Mauritius and Senegal

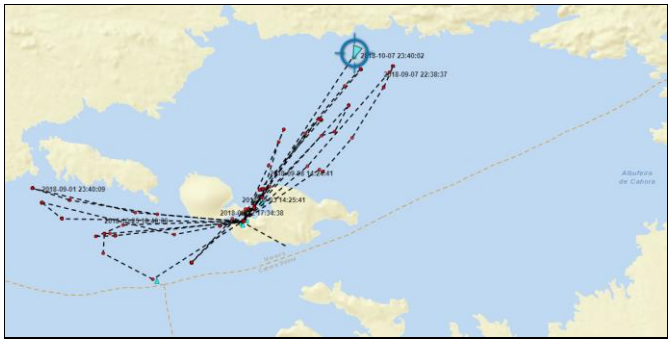
The Authorities in these two countries are planning their transponder deployments for December 2018.

Zanzibar

Transponders have been deployed on twenty anchovy fishing boats (dhows). The use of AIS is of interest to assist with safety of life and fisheries management.

Mozambique

For fisheries management and safety of life, twenty transponders have been deployed across small-scale fishing boats operating out of Maputo and on Lago de Cahora Bassa.



Seychelles

The SMSA is researching, from a safety of life perspective, mandating the use of AIS by all ships/boats (i.e. ferries, cargo, recreational, fishing) operating in Seychelles waters.

Namibia

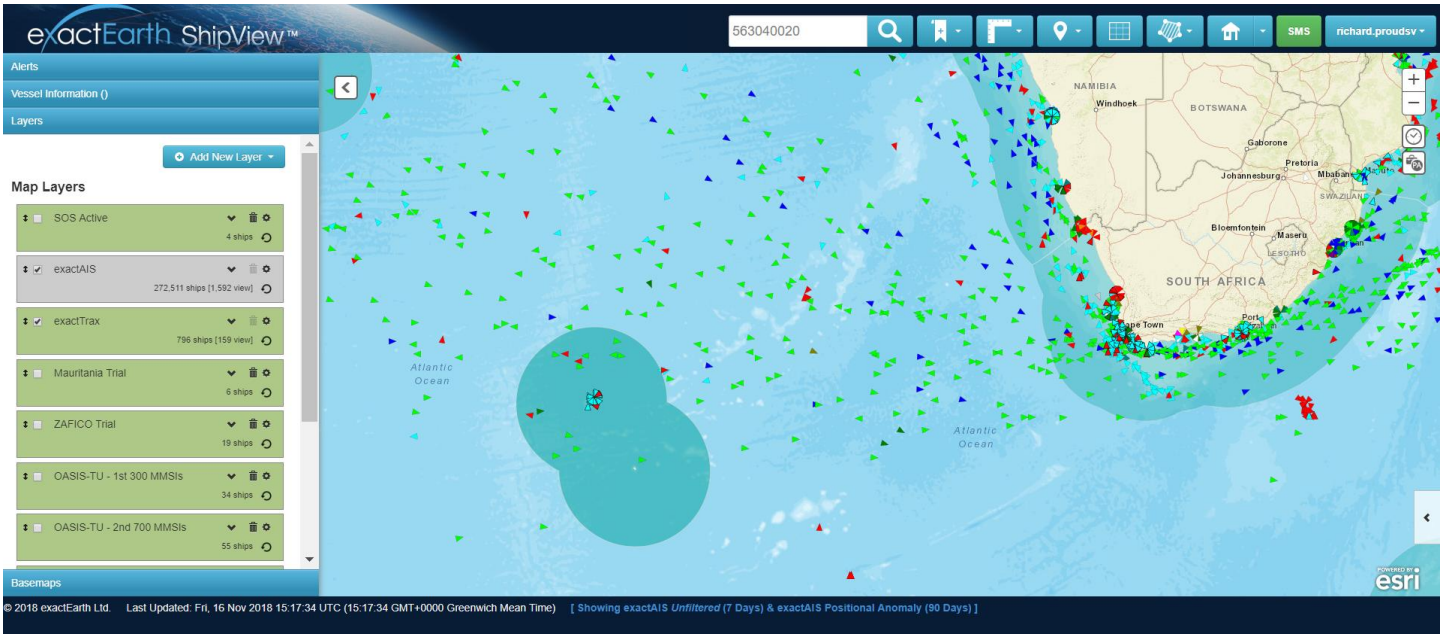
Safety of life is the main consideration here, not just for small fishing boats, but also work, tourist charters (e.g. seal and whale watching) and leisure boats.

Gambia

As well as artisanal fishing boat tracking, the Authorities are mandating the carriage of AIS by all fishing boats licensed to fish in Gambian waters.

Solution Deployment – Tristan da Cunha

Courtesy of SAMSA, and in partnership with Ovenstone Agencies, twenty-five (and five spare) exactTrax-enabled em-trak I100 AIS Identifier transponders have been supplied to rock lobster fishing boats operating in the waters around Tristan da Cunha, a remote group of volcanic islands in the Southern Atlantic Ocean and the name of the main island of that group. Ovenstone Agencies, based in Cape Town, is the concession holder for the Tristan rock lobster resource. Tristan da Cunha is part of the British overseas territory of Saint Helena, Ascension and Tristan da Cunha; Tristan's EEZ is shown below.



The lobster boats are a mixture of power boats launched from the MV Geo Searcher 'mother ship', that fish around Tristan's Outer Islands (Gough, Inaccessible and Nightingale), and those power boats launched from shore by the islanders themselves. Two ShipView licenses for tracking the boats have been made available to Ovenstone Agencies and Tristan's Communications Department.

Safety of life is the primary concern, but also fisheries management, as illegal fishing is a major concern in the region. A typical fishing day for a power boat will be 12 hours, but it is very weather dependent.

To the left is a photograph of an MV Geo Search powerboat, equipped with its exactTrax-enabled AIS transponder, prior to launching.

Below is a photograph of an islander's power boat, again equipped with its AIS transponder.

Sustainability and Exploitation

There are three main sustainability / exploitation aims on the OASIS-TU project:

- Post-project budget support by SAMSA to maintain the operational use of the transponders / exactTrax service deployed under the project
- Operational deployment of the trialed exactTrax technology in Madagascar
- Wider operational uptake of the trialed exactTrax technology in the extension partner and other countries.

South Africa

SAMSA has confirmed that it has a budget in place to cover the post-project cost of the 1,000 deployed transponders' exactTrax data supply into the MRCC. This data will also be made available to the NSRI.

Ovenstone Agencies has also confirmed that it will be covering the post-project operational cost for the 25 transponders deployed in Tristan da Cunha.

Madagascar

Following very successful exactTrax trials, the Malagasy stakeholders have collectively stated that their desire is to operationally deploy the technology. The challenge is to find suitable funding, as it is not practical for the Malagasy Government or local boat operators to cover the implementation costs, in particular, for the procurement of the necessary transponders. Therefore, the Malagasy Authorities, exactEarth Europe, Ibonia and Stone Three are proactively seeking third-party funding support.

Extension Partner Countries

Trials are due to complete in March 2018, and these will conclude with a series of feedback sessions. These will include any plans for future expanded deployments.

However, the Gambian Ministry of Fisheries has already decided to operationally deploy seventy 'AngelFish' exactTrax transponders on key commercial fishing vessels fishing in Gambian waters.

Further Afield

The World Bank funded the adoption of exactTrax by Ghana in 2017 for tracking its semi-industrial fishing fleet. exactTrax is also been trialed in the Comoros, Sierra Leone and Liberia, also via World Bank funding. Trials with commercial companies are also ongoing in Ecuador, Brazil and Japan, as well as under the Canadian MEOPAR programme and with the Great Barrier Reef Marine Park Authority.

Interest has also been shown by organisations from Kenya, Abu Dhabi, Honduras, Thailand, Malaysia and Kenya. Previous trials have taken place in Vietnam, the Lebanon, and Indonesia.

Current Benefit Realisation

Reduction in South African Small Boat-Related Deaths / SaR Budget Surplus via Service Efficiencies:

- At the time of writing, there have been no 'real-life' examples of lives being saved through the carriage of an exactTrax transponder, but various sea trials have been undertaken involving both SAMSA and the NSRI. These have demonstrated the utility of the technology in delivering the expected impacts.
- All partners remain, therefore, convinced of the utility / efficacy of the technology being delivered with respect to saving lives / saving SaR costs (>=15% saving year on year), but until the deployment of the transponders is complete and usage of the equipment is high, it will be difficult to demonstrate impacts through real-life incidents.
- However, it is also important to note that use of the technology in many ways can prevent incidents occurring. Under 2017 trials of exactTrax, consultants for the World Bank have reported that Sierra Leonian Tombo and Liberian Fante fishers in wooden artisanal canoes have been avoided by large ships actively changing their course based on receiving the local AIS signals from canoes equipped with exactTrax AIS transponders. Fishers previously had to quickly remove their fishing gear from the water or cut their nets if they saw a large ship approaching.

Cost Effectiveness Analysis:

- A CEA has been performed, comparing exactTrax to alternative approaches of (i) carriage of EPIRBs, and (ii) manning slipways to record boat movements. The analysis concluded that the use of satellite AIS and associated transponders is the most cost-effective of the three options in both 2017-2021 & 2017-2023 timeframes.

Operational Uptake of exactTrax in Madagascar:

- The trials, which completed in October 2018, have been judged to be a great success. As such, it has been made clear by the CFIM that it would very much want to proceed with an operational deployment of the technology/service post-project (initially for 1,000 boats). External funding is being sought for this.

Increased Capability to Use Space Expertise:

- To date, 213 people across nine African countries have been trained in satellite AIS and exactTrax.

Strengthened Partnerships:

- Directly related to the OASIS-TU project, exactEarth Europe is currently engaging with nineteen different organisations across nine African countries.

Growth in the South African Economy:

- The development of the 'AngelFish' transponder by Stone Three has allowed the company to employ additional staff and to create a local supply chain involving five other local South African companies. Further growth is anticipated when large quantity orders, such as the potential Madagascar deployment, are realized.

Technology / Project Promotion:

- Currently, the IPP and the OASIS-TU project have been presented at nine conference events, in two publications and to five other NGO organisations outside the project partners.

Current Conclusions

The Madagascar project component is complete; the South Africa component will complete in February 2019; and the extension component will finish in March 2019. A legacy Monitoring & Evaluation (M&E) review for the South Africa component is planned for February 2020.

At this stage the following interim **conclusions** can be made:

South Africa:

- After a long delay in issuing MMSIs for the transponders, deployments have been proceeding well.
- Several live SOS tests with the NSRI and SAMSA have demonstrated the service works well and can save time related to SaR operations, and therefore by extension, lives and costs.
- Persuading boat users, particularly fishers, to use the transponders is not easy and will require continuous follow-up beyond the project end-date to persuade them of the benefits and that SAMSA is not using the technology to track their fishing habits.
- The target number of boats to be equipped in South Africa will be ~1,000. If we assume that on average a typical small boat will carry 5 crew (some very small cray fish boats will carry 2 crew, some bigger line fishing boats will carry 8), then we could predict that at some stage, 5,000 people will directly benefit from the use of the technology. If each crew member has an immediate family of three others, that would be a further 18,000 people indirectly benefitting from the technology.

Madagascar:

- The exactTrax technology and service trials have been judged by all participants to be a great success.
- A compelling, new exactTrax compatible transponder product is now available for international exploitation.
- An excellent opportunity exists for a full operational deployment of exactTrax in Madagascar to underpin small boat maritime security, fisheries management and safety of life. The challenge is to find suitable third-party funding to support this.

Extension Partners:

- Trials are progressing very well, with good use of the SAMSA-loaned transponders by most participants.
- We would hope that a number of the trials will result in participating countries wishing to deploy the technology operationally; indeed, the Gambia has already ordered seventy 'AngelFish' transponders and associated exactTrax services.

With respect to interim '**Lessons Learned**', the following are suggested:

- A local in-country project management office, independent from the in-country stakeholders / end users, would be a big help, if practical.
- Local champion(s) are key to success, due to the distances involved, understanding of local politics, language, ease of quick communication if required, especially face-to-face, etc..
- There can be a very different mindset between local parties and project management as to what constitutes being active / keeping to the agreed plan.
- Adopt a longer-term results mindset – expected results may not always arrive within the project plan.
- With respect to what constitutes an in-country organisation that would make an ideal partner, an introduction from a third-party with direct experience of that partner country /organisation could be beneficial.