BLUE ECONOMY
COOPERATIVE RESEARCH CENTRE

Australian Government
Department of Industry, Science, Energy and Resources

AusIndustry
Cooperative Research Centres Program

SHORT SUMMARY

1.20.002 Autonomous Marine Systems at Offshore Aquaculture and Energy Sites

INTRODUCTION

This scoping study finds a clear demand among surveyed industry partners for increased use of AMS in their operations. The breadth of AMS technologies and applications is significant. As such, there is unevenness both in the readiness of platforms to meet industry needs, and in the understanding of partners as to the specific roles that AMS will play in the future.

KEY POINTS

- As aquaculture and renewable energy moves offshore there is a need to find technologies that perform inspection and maintenance tasks.
- A survey of industry partners reveals operational needs that are not currently met in sensing, command and control systems, as well as localisation and navigation.
- The report describes the challenges of bridging the "Valley of Death" in research commercialisation and proposes a focus for BE CRC on mid-stage technology development to accelerate the development of academic research through to scalable solutions.
- The need to focus on specific aspects of offshore autonomous systems means that it will be important to consider building development platforms that can then be translated into solutions.

THE CHALLENGE

Making offshore/high energy fish farms and tidal energy systems safe and financially viable means a step-change in the adoption of technologies Autonomous Marine Systems (AMS). AMS have seen rapid development over the past 20 years, with advances in battery, computer, sensing and communication technology enabling vehicles that are capable of multi-role survey and on-the-fly mission adaptation. In spite of these developments, there are currently no solutions on the market that can completely replace human staff at offshore/high energy sites.

The potential uses for AMS in the offshore environment vary widely, including the continuous monitoring of the marine environment, undertaking maintenance tasks, and inspecting key infrastructure. The areas of offshore sites where AMS might be deployed (Figure 1) directly impacts the current readiness of commercially available solutions to operate safely and reliably.

For example, surface craft in open water can rely on satellite navigation and communications with relatively few hazards with which to contend. Conversely robots that operate underwater in or around fish pens must avoid lines and moving nets, all while trying to calculate their position without the benefit of systems such as GPS.

Scientists and engineers are developing autonomous capabilities but matching promising systems with industry need and driving them through to commercial use remains a challenge.

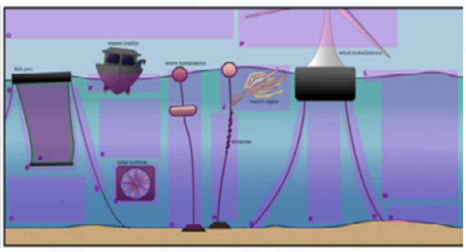

Figure 1. Segmentation of domains of operation for offshore autonomous marine systems.

The Blue Economy CRC is funded in part under the Australian Government's CRC program administered by the Department of Industry, Science, Energy and Resources.

BLUE ECONOMY COOPERATIVE RESEARCH CENTRE

Australian Government Department of Industry, Science, Energy and Resources | AusIndustry Cooperative Research Centres Program

SHORT SUMMARY

1.20.002 Autonomous Marine Systems at Offshore Aquaculture and Energy Sites

THE OPPORTUNITY

The Blue Economy CRC brings together a diverse group of industry stakeholders and researchers, which presents an opportunity to bridge the gap that exists between industry need and academic research. By meeting with industrial partners and understanding their goals, specific technology gaps can be identified.

Once described, these gaps become a roadmap for development. The gaps themselves require the engagement by researchers across multiple disciplines, from robotics, to control theory and communications, as well as specialists in industry operations, and data analysis. The BE CRC is thus an opportunity to bring these researchers together to collaborate and build and test concepts and prototypes that address targeted problems, with end-user involvement throughout.

OUR RESEARCH

Step 1. Ask the audience
The key to identifying relevant technology gaps is to start with the question on what industry needs. A survey was sent to industry partners of the BE CRC with questions that probed the current use of autonomous technology, problems faced in adopting technology, limitations for power and communications at offshore sites, the work done by humans that might be too dangerous or difficult to conduct when operations move offshore and the frequency and urgency of different tasks. The survey responses built a picture of work currently undertaken and the expectations of how it will change in the future.

Step 2. Decompose
The survey responses were laid out and described.

From the answers, which came from both aquaculture and renewable energy partners, three specific user cases became clear. Partners need solutions for monitoring the environment around sites, visually inspecting infrastructure and performing maintenance and repair. These three requirements were then described according to their locations, centres of control (Figure 2), precision, sensors etc., by using a Decomposition Tool that asks a series of questions about the requirements.

Step 3. Map
Once the individual components of the problem were described they were mapped to technologies, both commercially available and in development. Knowing the profile of technological readiness across a potential solution helped to identify areas of weakness that need support before a platform can advance to being a viable, fully featured answer to an industry problem.

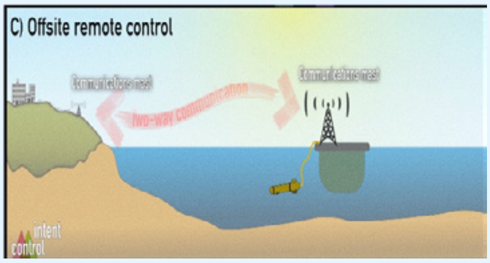

Figure 2. An example of a control scheme that might be employed, where humans stay onshore and communicate directly with offshore robots.

Step 4. Prioritise
Understanding the readiness of potential solution allowed for the categorisation of the research needed to make it mature. Some elements exist at a low level of readiness, as primary research within academic institutions.

The Blue Economy CRC is funded in part under the Australian Government's CRC program administered by the Department of Industry, Science, Energy and Resources.

BLUE ECONOMY
COOPERATIVE RESEARCH CENTRE

Australian Government
Department of Industry, Science, Energy and Resources

AusIndustry
Cooperative Research Centres Program

SHORT SUMMARY

1.20.002 Autonomous Marine Systems at Offshore Aquaculture and Energy Sites

These may take a long time to mature and carry the inherent risks of all early-stage development; they may not work, and costs are hard to predict. Elements at a high level of readiness may need a push to commercialisation but in general they have undergone significant development and now need final reliability testing and scaling. These are nearly ready for deployment and need manufacturer attention, more than academic. The prioritisation step classifies the mapped technologies by both their readiness and relevance. Innovations that fall in the middle of the readiness scale, and those that are highly sought after by industry partners are those that are most highly recommended by the report.

OUTCOMES

Industry partners reported a significant need for innovation in remote and autonomous systems to make their offshore operations safe and efficient. Reduction of risk to people and business was identified as a key concern. There is a mix of solutions needed to achieve industry goals, both remotely control and autonomous.

The mapping of detailed requirements highlighted gaps that exist in the sensing of the marine environment, the safe and autonomous control of vehicles that operate around offshore sites, and the technologies that underpin precise navigation underwater. In all cases there are exciting opportunities that fall within the readiness ranges most likely to see a benefit from BE CRC support.

NEXT STEPS

The report produced as part of this project recommends that the technology gaps in meeting industry requirements are relevant for research support by the BE CRC. It also recommends that intermediate platforms be considered, where technologies can be trialled and shown to be reliable, as steppingstones to prototype commercial systems. The tools developed for interpreting the responses to the industry survey (Decomposition, Mapping & Prioritisation) may be useful in interpreting industry needs as they emerge in the future, and can be used for assessing the relevance of proposed solution and likely impact of Blue Economy CRC support.

The Blue Economy CRC is funded in part under the Australian Government's CRC program administered by the Department of Industry, Science, Energy and Resources.

SHORT SUMMARY

1.20.002 Autonomous Marine Systems at Offshore Aquaculture and Energy Sites

PROJECT TEAM

- Alistair Grinham, University of Queensland
- Andreas Marouchos, CSIRO
- Andrew Martini, CSIRO
- Andy Fischer, University of Tasmania
- Boon-Chong Seet, Auckland University of Technology
- Damien Guihen, University of Tasmania
- Guy Williams, University of Tasmania
- Jane Symonds, Cawthron Institute
- Jeff Ross, University of Tasmania
- Josh Soutar, Xylem
- Kevin Heasman, Cawthron Institute
- Loulin Huang, Auckland University of Technology
- Mary-Anne Lea, University of Tasmania
- Matthew Leary, Tassal
- Pavan Sikka, CSIRO
- Peter King, University of Tasmania
- Remo Cossu, University of Queensland
- Serean Adams, Cawthron Institute
- Shantha Jayasinghe Arachchillage, University of Tasmania
- Simon Albert, University of Queensland
- Stephen Cahoon, University of Tasmania
- Steve Bird, Xylem
- Rod Connolly, Griffiths University
- Simon Edwards, University of Tasmania
- Raymond Bannister, EPA Tasmania

PROJECT REPORTS/PUBLICATIONS

Guihen, D. et al. (2020). Autonomous Marine Systems at Offshore Aquaculture and Energy Sites, 1.20.002 – Final Project Report. Launceston, Australia: Blue Economy Cooperative Research Centre.

The Blue Economy CRC is funded in part under the Australian Government's CRC program administered by the Department of Industry, Science, Energy and Resources.