2019 ANNUAL PROGRESS REPORT

OceanWorks

Part of the Woodside FutureLab Network

We acknowledge that the University of Western Australia is situated on Wadjuk Noongar land, and that the Noongar people remain the spiritual and cultural custodians of their land, and continue to practice their values, languages, beliefs, and knowledge. We would like to pay our respects to Elders past, present, and emerging.

Image: School Visit from the year 5 class from PLC

EXECUTIVE SUMMARY

This Progress Report has been prepared against the criteria of Item 8(d) of the Funding Agreement, dated November 2015, between The University of Western Australia and Woodside Energy Limited, and the KPIs revised in September 2019.

OceanWorks is a joint initiative between the University of Western Australia (UWA) and Woodside Energy Limited (Woodside) aimed at enriching research capabilities and increasing responsiveness to industry's current and future needs.

The activities of OceanWorks are overseen by the OceanWorks Advisory and Governance Committee (OWAGC). In 2019 OceanWorks welcomed Tina Zhang (Communications Officer), Zach Aman (Chair of Long Subsea Tiebacks), Julian Partridge (Oceans Institute), Cam Batemen (Technology Manager, Woodside), and Jan Flynn (Chief Metocean Engineer, Woodside) to this committee.

In September the OceanWorks KPIs were revised to better capture the successes and outcomes of OceanWorks. The new KPIs cover the governance, strategy, relationship, education, and outreach activities of OceanWorks. OceanWorks has delivered strong results in 2019 and has met or exceeded all KPIs.

In 2019 OceanWorks welcomed over 4800 visitors (a 49% increase on 2018) and hosted over 290 events. The RiverLab program supported a record number of students this year, and the internship program expanded to include 6 international students over the winter break, and 7 local students over summer. The OceanWorks prototype fund established in 2018 supported 11 new projects in 2019, and hosted 3 challenge sessions in collaboration with Woodside.

OceanWorks outreach activities continue to focus on providing programs and support to address the need for greater gender diversity in engineering. New initiatives include the Emerging Engineers Competition for high school students, and the Life Under Water Art Competition for primary school students. Existing programs, including the Women of IOMRC Network continue to provide support for professional engineers.

SUMMARY OF KPIS

In 2019 all KPIs were met, Of the 5 contractual KPIs, 3 were achieved, 1 was in progress, and 1 was newly introduced in Q4 and did not have a target set. Of the 12 agreed KPIs, 11 achieved an outstanding rating, and 1 achieved a satisfactory rating. This report provides a detailed summary of each KPI and the activities undertaken to achieve it.

CONTRACT

KPI 1.1 The OceanWorks Advisory Committee to meet regularly	**ACHIEVED**
KPI 1.3 Number of visitors to the OceanWorks Space	**ACHIEVED**
KPI 1.4 Number of events held in the OceanWorks Space	**ACHIEVED**

STRATEGIC

KPI 2.1 Number of prototypes initiated with direct Woodside Involvement.	**POOR**	**SATISFACTORY**	**OUTSTANDING**
KPI 2.2 Number of challenge sessions focused on Woodside strategic issues	**POOR**	**SATISFACTORY**	**OUTSTANDING**
KPI 2.3 Quantity of reseach ideas being generated and investigated	**POOR**	**SATISFACTORY**	**OUTSTANDING**

RELATIONSHIP

KPI 3.1 Number of Woodside/UWA Engagement Activities	POOR	SATISFACTORY	OUTSTANDING
KPI 3.2.1 Both Parties promote OceanWorks within their organisation as a tool for innovation and engagement: events circulated	POOR	SATISFACTORY	OUTSTANDING
KPI 3.2.2 Both Parties promote OceanWorks within their organisation as a tool for innovation and engagement: points of contact made	POOR	SATISFACTORY	OUTSTANDING
KPI 3.3 Both Parties are sufficiently aware of the activities of OceanWorks and Outcomes from Projects	POOR	SATISFACTORY	OUTSTANDING

EDUCATION

KPI 4.1.1 The number of students involved in OceanWorks projects: RiverLab	POOR	SATISFACTORY	OUTSTANDING
KPI 4.1.2 The number of students involved in OceanWorks projects: Internships	POOR	SATISFACTORY	OUTSTANDING
KPI 4.1.3 The number of students involved in OceanWorks projects: Overall engagement	POOR	SATISFACTORY	OUTSTANDING

OUTREACH

KPI 4.1 To support programs that will increase inclusion and diversity	POOR	SATISFACTORY	OUTSTANDING
KPI 4.2 To increase community awareness of OceanWorks through outreach activities and communications	POOR	SATISFACTORY	OUTSTANDING

CONTENTS

CONTRACT

1.1 GOVERNANCE

1.2 SUSTAINED FUNDING

1.3 VISITORS

1.4 EVENTS

1.5 INDUSTRY ENGAGEMENT

In 2019 OceanWorks' KPIs were renewed to better capture the success of OceanWorks and to ensure its activities more closely align with Woodside's strategic goals.

The renewed KPIs have replaced the KPIs from the original OceanWorks Funding Agreement, with 5 KPIs from the original agreement being retained. The KPIs in this section concern OceanWorks governance and space usage. Four of the five KPIs have been achieved, with the remaining KPI (1.2 Sustained Funding) on track for completion by November 2020.

GOVERNANCE

KPI 1.1 The OceanWorks Advisory Committee to meet regularly

The activities of OceanWorks are overseen by the OceanWorks Advisory and Governance Committee (OWAGC). The OWAGC has two sub-committees that report to it on specific activities; the OceanWorks Strategy and Planning Committee (OWSPC) who oversee the long-term business planning for OceanWorks, and the RiverLab Advisory Panel (RAP) who oversees the activities of the RiverLab Program.

The day-to-day activities of OceanWorks are managed by the co-academic leads (Scott Draper and Andrew Grime) the OceanWorks Curator (Ruth Thomas) and the OceanWorks Communications Officer (Tina Zhang).

The Committee is required to meet regularly - in 2019 it met on a monthly basis. The minutes from past meetings are available on the OceanWorks OneDrive.

ACHIEVED

OCEANWORKS ADVISORY AND GOVERNANCE COMMITTEE

The OWAGC was established in accordance with section 2(a) of the *OceanWorks Implementation Plan.*

The purpose of the committee is to:

- promote the successes of OceanWorks.
- meet on a regular basis to oversee the annual program.
- review engagement and key performance indicators. In 2019 the KPIs were revised.

In 2019 the OWAGC welcomed Cam Bateman, Jan Flynn, Zach Aman, Julian Partridge, and Tina Zhang to the Committee.

Scott Draper Chair and Faculty representative Hydrodynamics
Andrew Grime Faculty representative Structures
Phil Watson Faculty representative Geotechnics
Nicole Jones Faculty representative Oceanography
Julian Partridge Faculty representative Marine Biology
Zach Aman Faculty representative LNG Futures and Long Subsea Tiebacks
Ruth Thomas OceanWorks Curator
Tina Zhang Communications Officer
Pru Steinerts Business Development Manager
Rob Shannon Associate Director of Innovation
Cam Bateman Technology Manager, Woodside
Jan Flynn Chief Metocean Engineer, Woodside

SUSTAINABLE FUNDING

KPI 1.2: Sustained Industry-University Funding within 5 years

OceanWorks aims to obtain funding from Industry for a further 5-year term by the end of its current contract (April 2021).

The OceanWorks Strategy and Planning Committee (OWSPC) has been tasked with addressing this KPI. The OWSPC reports on its progress to the OWAGC on a quarterly basis.

In 2019 OWSPC developed a new funding strategy and identified potential industry partners to join OceanWorks. The OWSPC plans to approach new partners for funding in 2020.

The timeline for achieving this KPIs is April 2021.

OCEANWORKS STRATEGY AND PLANNING COMMITTEE

The OWSPC was established to undertake the long-term business planning required to make OceanWorks financially sustainable by November 2020, as required by the *OceanWorks Funding Agreement* (see *Implementation Plan*, s1).

The OWSPC has been tasked with investigating additional revenue streams and financial support for OceanWorks, by the OWAGC.

In 2019 the Committee identified potential future partners and commenced work on a renewed funding strategy. In 2019 the OWSPC met five times.

Scott Draper
Associate Professor, Oceans Graduate School
Phil Watson
Shell Chair, Director Offshore HUB
Robert Pemberton
Business Support Manager, Oceans Institute
Ruth Thomas
OceanWorks Curator
Pru Steinerts
Manager, Innovation and Industry Engagement
Rob Shannon
Associate Director, Innovation
Christophe Gaudin
Head of School, Oceans Graduate School
Gia Parish
Associate Dean, School of Engineering

SPACE USAGE

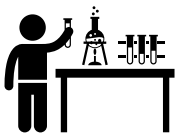
The OceanWorks Space (Space) is part of the in-kind support provided by UWA. The Space aims to build collaboration between Woodside and UWA by providing a venue for Industry to use and hosting a program of collaborative events.

There are three KPIs associated with the Space usage: the number of visitors to the Space, the number of events held in the Space, and the proportion of industry events held in the Space. Targets for the KPIs were set in December 2018. Throughout 2019 data was collected by the OceanWorks Curator and reported to the OWAGC on a quarterly basis.

In 2019 there was a significant increase in both the number of events held in OceanWorks (25%), and the number of visitors to the Space (40%) when compared to 2018 values. Engagement with Woodside continues to be strong, with an average of 35% of events held in the Space directly involving the broader Industry.

KEY IMPROVEMENTS

In 2019 three significant improvements were made in the OceanWorks Space. The purpose of these improvements was to enhance the experience of visitors to the Space.



Facility Tours
In September 2019 Facility tours were introduced as an optional add-on for industry bookings of the Space. Current facilities on offer include the NGCF Centrifuge and the Gliders Labs.

Technology Assessment
The first technology assessment of the Space was conducted in September 2019. This assessment was led by Erin Patterson (UWA IT, Business Partner) and provided an evaluation of current IT facilities in the space, as well as suggestions for improvements that would enhance the experience of visitors to the Space.

Coffee Machine Upgrade
The OceanWorks coffee machine makes over 70,000 cups of coffee a year. In 2019 the machine was upgraded to accommodate the higher than expected usage. The machine is available to all visitors to the Space and provides informal opportunities for interaction between UWA academic staff and Industry visitors.

VISITORS

KPI 1.3 Number of visitors to the OceanWorks Space

Data is collected on the number of attendees for events held in OceanWorks. This information is collated and reported to the OWAGC on a quarterly basis.

In 2019 over 4834 people visited the Space. This is a 49% increase on the number of visitors in 2018 (3225 visitors).

The target for this KPI is 300 visitors per month. This target was set by the OWAGC in December 2018. This target was exceeded every month this year, with the exception of January and February. On average the monthly target was exceeded by 34%.

TARGET
300 PER MONTH

ACHIEVED
402 AVERAGE/PER MONTH

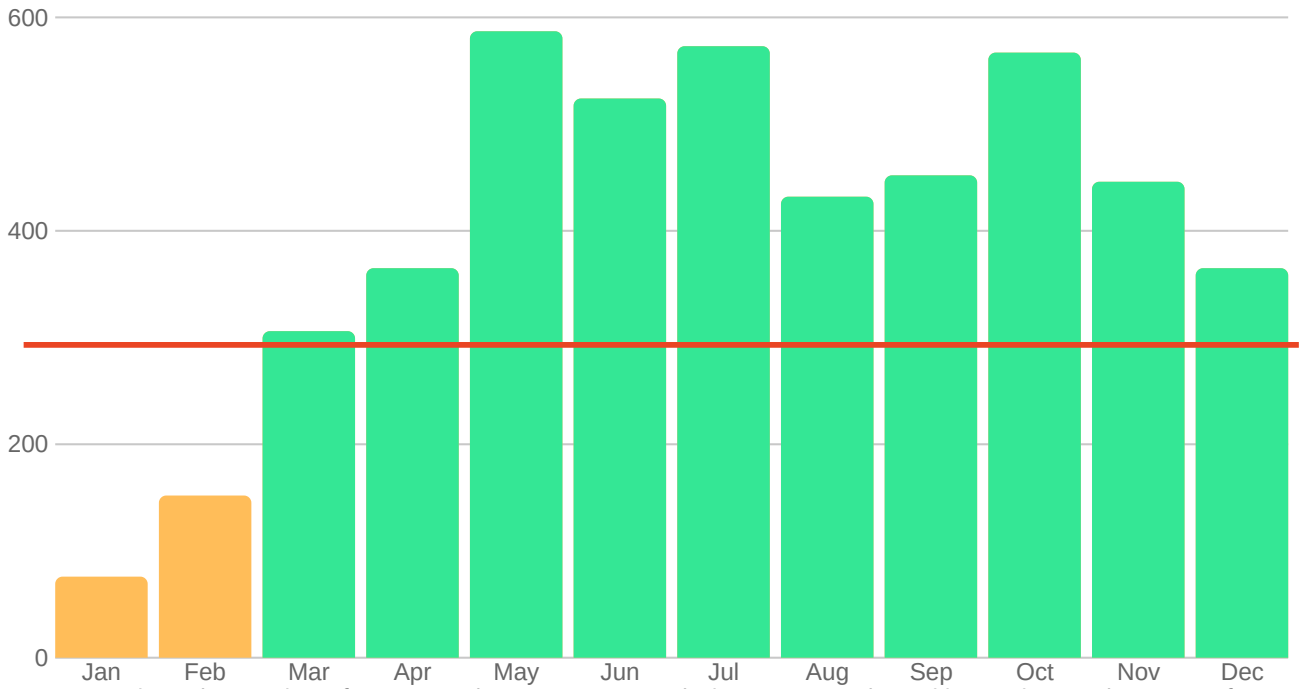


Figure: tracking the number of visitors to the space per month during 2019. The red line indicates the target of 300 visitors to months

EVENTS

KPI 1.4 Number of events held in the OceanWorks Space

Data is collected on the number of events held in OceanWorks. This information is collated and reported to the OWAGC on a quarterly basis.

In 2019 over 293 events were held in the OceanWorks Space. This is a 9% increase on the number of events held in 2018 (267 events) and a 73% increase on the number of events held in 2017 (167 events).

The target for this KPI is 15 events per month. This target was set by the OWAGC in December 2018. This target was exceeded every month this year, with the exception of January. On average, the monthly target was exceeded by 60%.

TARGET 15 PER MONTH	ACHIEVED 24 AVERAGE/PER MONTH

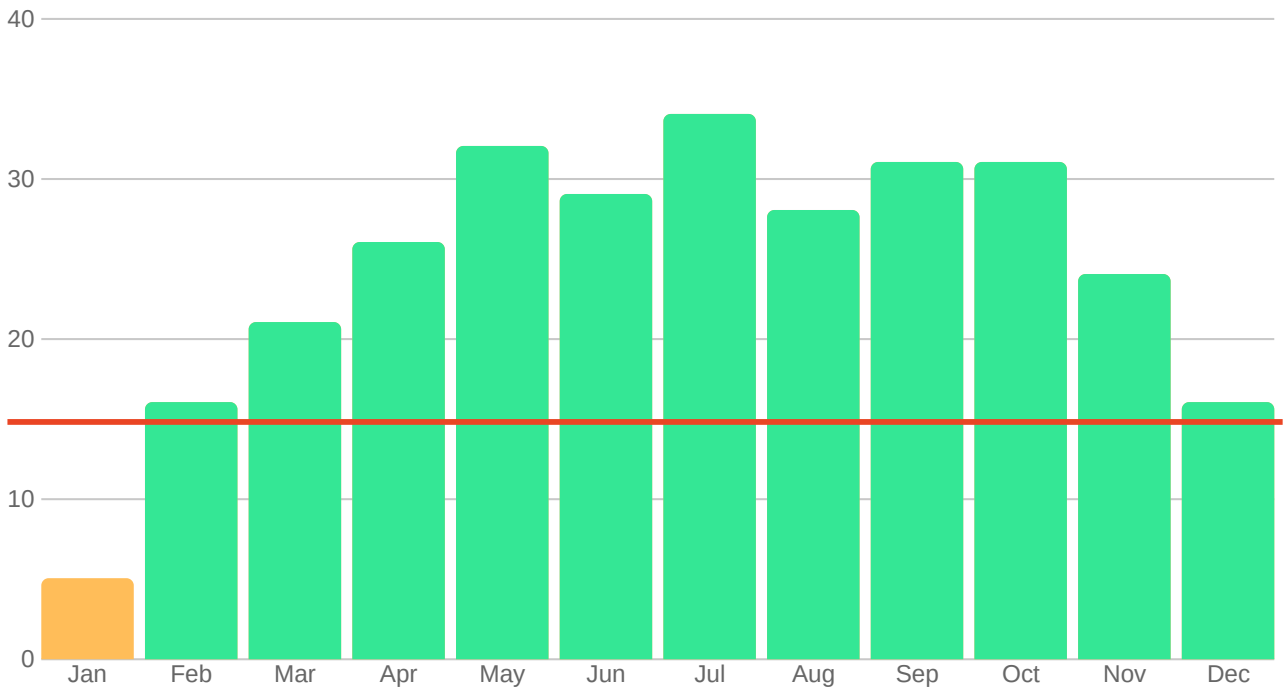


Figure: tracking the number of events in the OceanWorks space per month during 2019. The red line indicates the target of 15 events per month.

INDUSTRY ENGAGEMENT

KPI 1.5 Proportion of events held in the OceanWorks Space involving Industry

Data is collected on the proportion of events held in OceanWorks that directly involve industry. This information is collated and reported to the OWAGC on a quarterly basis.

For the purposes of tracking this data, 'industry events' include events that are either organised by Industry (e.g. Woodside Away Days) or that involve active participation from Industry (e.g. workshops with the ARC Offshore Hub).

This KPI was introduced in August 2019 and no target has yet been set by the OWAGC.

In 2019 an average of 34% of events held in OceanWorks directly involved Industry.

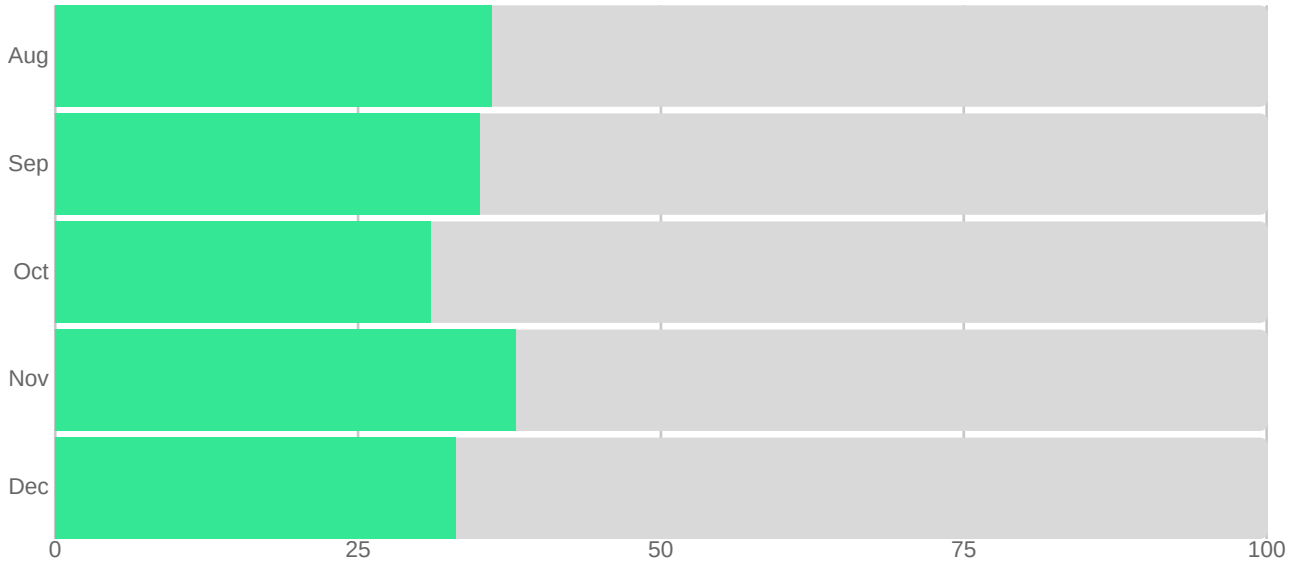


Figure: tracking the proportion of events held in OceanWorks that involved industry from Aug-Dec 2019.

STRATEGIC

2.1 PROTOTYPES

2.2 CHALLENGE SESSIONS

2.3 RESEARCH

In order to better align the activities of OceanWorks with Woodside's Strategic Issues, three KPIs have been implemented to track OceanWorks activities involving research and collaboration between industry and academia.

Since its launch in 2018 the OceanWorks prototyping fund has proven to be a successful pathway for rapidly testing solutions for industry problems and has consistently produced high quality results. In 2019 targets have been set for the number of prototyping projects funded on an annual basis that have direct involvement from Woodside, and the number of challenge sessions that focus on Woodside strategic issues.

PROTOTYPES

KPI 2.1 Number of projects (prototypes) initiated with direct Woodside Involvement.

The purpose of this KPI is to ensure the research undertaken through OceanWorks broadly aligns with Woodside's business. This KPI is measured by the number of prototypes funded through OceanWorks that have direct involvement with Woodside.

In 2019, 11 prototypes were funded through OceanWorks, and 10 of the prototypes funded had direct Woodside involvement.

Applications for funding are considered by the OceanWorks Advisory and Governance Committee(OWAGC) on a monthly basis. All applicants are required to articulate the project's potential value to industry, and should involve an industry partner.

The target for this KPI is 10 prototypes annually. This target was set by the OWAGC in September 2019 and has been met.

POOR	SATISFACTORY	OUTSTANDING
3 PROTOTYPES	6 PROTOTYPES	10 PROTOTYPES

THE PROTOTYPE FUND

The OWAGC provides small grants (up to $5000) from the Prototype Fund to support innovative research that has the potential to have a significant impact within industry.

UWA academics are encouraged to present their idea to the OWAGC, who assess applications and award funding to projects that are considered capable of producing valuable outcomes. After the project has been completed the project owners are invited to present their findings to the OWAGC and Industry.

Since its inception in July 2018, the Prototype Fund has supported 19 projects. In a valuation prepared for Woodside in May 2019 the collective outcomes generated by the prototype projects were estimated to return an expected value of $31 million to Woodside's business. Further information on this valuation can be found in Appendix 1 (p68).

$31

MILLION EXPECTED VALUE GENERATED SINCE 2018

IDEATE → PROTOTYPE → OUTCOMES

The OWAGC approves funding for ideas that have the potential to impact Industry

Ideas are researched and developed by UWA academics and students

Outcomes are presented to Industry and, if required, are developed further

2019

11 PROTOTYPES APPROVED

4 PROTOTYPES COMPLETED

7 PROTOTYPES IN PROGRESS

$69,000 PROTOTYPE FUNDING

31 ACADEMICS COLLABORATING ON INDUSTRY PROBLEMS

10 WOODSIDE PROJECTS

3 CHALLENGE SESSIONS

$31 MILLION
EXPECTED VALUE GENERATED FOR WOODSIDE
SINCE 2018

SCOURING ASSESSMENT OF COMPOUND SUBSEA STRUCTURES: FIELD OBSERVATIONS VS STATE OF THE ART PRACTICE

UWA Contacts
Scott Draper
Hongwei An
Liang Cheng

Industry Contacts
Meysam Banimahd (Woodside)

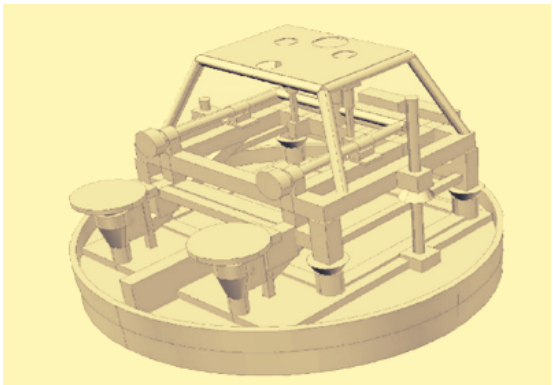


Image: 3D model of subsea structure analysed.

The Problem
Scouring assessments for subsea structures are usually conducted using methodologies and assumptions established for surface piercing structures (e.g. bridge piers). Most of these methods are also based on small scale laboratory experiments which model idealised flow conditions and seabed sediments. The application of these methods to subsea structures in the field therefore leads to some inevitable uncertainties. This existing gap in practice is exacerbated by a lack of reliable field data to benchmark the respective methodologies and assumptions.

The Process
This projects aims to execute a 'seed' project whereby high quality field observations of scour around a subsea structure will be back-analysed to demonstrate that with the right technology / approach, we can effectively predict scour and therefore address scour related challenges. The technology and approach utilised in this case will be carefully constructed model scale experiments which aim to mimic field conditions, and account for actual structural geometry (using 3D printing) and site specific sediment and metocean conditions.

The Impact
Results from this project have been presented at two conferences (Australian Oil and Gas 2019 and the First Vietnam Symposium of Advances in Offshore Structures 2018) and a journal publication is in preparation. The results have also led to discussions concerning a wider industry research project, which would have an ultimate aim of developing improved design guidelines for scour assessment of subsea structures.

DESIGN ENGINEERING FOR SEABED PORCUPINE

UWA Contacts
Terry Griffiths
David White

Industry Contacts
Voula Terzoudi (Woodside)
Harvey Smith (Woodside)

Image: Terry Griffiths visits Trelleborg UK

The Problem
UWA continues to undertake globally-leading research into the behaviour of subsea cables and pipelines, with a particular focus on how the hydrodynamics are affected by the cable interaction with different types of seabed. Through the research undertaken by a number of researchers, significant progress has been made in developing improved understanding of cable behaviour on rocky seabeds.

The Process
With the generous support of OceanWorks, while in Europe attending OMAE, Terry Griffiths was able to add a side-visit to the manufacturing facility for Trelleborg Offshore UK (TOUK) in Skelmersdale (near Liverpool) to meet with key technical personnel involved in new product development – Andy Smith (head of R&D) and Geoff Wild (lead product designer).

The Impact
The visit was enormously productive in helping to progress discussions on some of the novel products being developed by TOUK and how the research being undertaken at UWA could complement these efforts, helping to deliver practical and cost-effective solutions for marine renewable and offshore oil and gas industries.

TOWARDS IMPROVING PIPELINE STABILITY DESIGN FOR SOLITONS

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Andrew Zulbati
Matt Rayson
Hongwei An

Industry Contacts
Andrew Pearce (Woodside)

Image: subsea pipeline flange being inspected by an ROV

The Problem
Non-linear Internal Wave (NLIW) induced currents are prevalent at numerous locations offshore the North West Shelf and elsewhere around the world. Routing pipelines through areas of significant NLIW activity requires careful design to ensure the pipeline remains stable when subjected to large near-bed currents.

The Process
The aim of this project has been to review (1) existing design practice concerning pipeline stability design in locations where NLIW are significant, and (2) recent research findings on NLIW and pipeline stability assessment which may be used to improve upon this existing practice.

The Impact
Based on the review, a list of recommendations have been made and shared with Woodside. A unique meeting was also hosted by UWA and Woodside to share the recommendations with representatives from four of the main pipeline engineering consultancies and a classification society. This has led to refinement of the recommendations, and has motivated further work.

PLANNING THE RECOVERY OF AN ANTI-MARINE GROWTH STRUCTURE

UWA Contacts
Marie-Lise Schlappy
Terry Griffiths

Industry Contacts
Harvey Smith (Woodside)
Yan Mei Ng (Woodside)

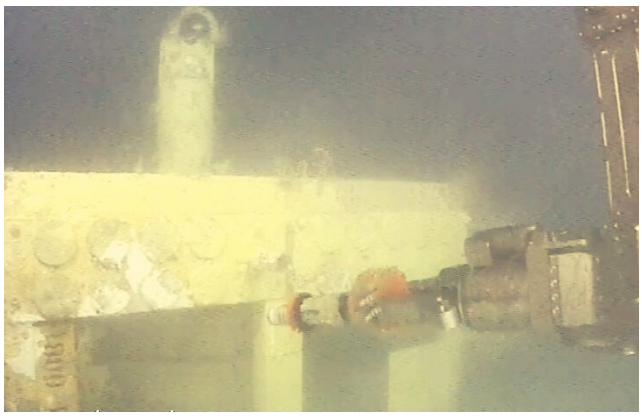

Image: The Woodside structure to be recovered.

The Problem
Oil and gas subsea equipment can be impacted by marine growth resulting in costly equipment failure across industry. Woodside deployed an Anti-Marine Growth Structure (AMGS) to investigate how different types of equipment react to seawater exposure in deep waters. Academics provided information on the types of deposits which could be found on the structures.

The Process
In this prototype UWA staff propose to create a plan to recover the structure and to determine the type of science investigation required on the AMGS to avoid equipment failure in the future.

The Impact
This project will deliver a technical note about the structure that Woodside will use in its recovery.

SHEER STRESS AMPLIFICATION AND SCOUR AROUND SUBSEA STRUCTURES

UWA Contacts
Scott Draper
Joe Tom
Weidong Yeo

Industry Contacts
Meysam Banimahd (Woodside)

Image: Subsea structure settling due to scour on a mobile sediment bed.

The Problem
Offshore and coastal infrastructure are susceptible to local scour, where sediment is removed from the area adjacent to the structures due to waves and currents. This phenomenon can endanger the stability of seabed structures, such as offshore energy infrastructure or artificial reefs at beaches. Scour remediation and protection is costly and improved design of scour protection could increase infrastructure safety and reduce costs to industry and society.

The Process
In this project, a series of physical model experiments will be undertaken in the laboratory at UWA to develop a new method to predict the enhancement of water flow around different types of subsea structures and the potential for scour.

The Impact
The results of this project will lead to new techniques to design structures against scour and improved scour prediction methodologies for the offshore and coastal engineering industries.

TESTING WATERS WITH DNA ZOO TECHNOLOGY TO BUILD GENOMIC RESOURCES FOR CRITICAL MARINE HABITAT-FORMING SPECIES OF SEAGRASSES

UWA Contacts
Matthew Fraser
Belinda Martin
Mitchell Booth
Parwinder Kaur

Industry Contacts
Shaun Wilson (Dep. of Biodiversity, Conservation and Attractions)

Image: Seagrasses

The Problem
Marine ecosystems are fundamentally altered by climate change. Understanding the responses of habitat-forming species to changing climate has become a major conservation requirement in the Anthropocene. One major factor determining the response of organisms to stressors (like increasing temperature) is their genetic potential to acclimate and adapt. However, predictions of such "genetic resilience" depend on the availability of high-quality genome sequences, which has previously been cost-prohibitive, limiting the number of marine organisms with high quality genomes that have been published.

The Process
To address this problem the team will apply the novel approach of DNA Zoo to build high-quality, chromosome-length genomes for habitat-forming WA seagrasses. Recent advances in sequencing technologies and bioinformatic analysis have reduced the cost of producing such genomes, opening up this exciting new resource for use in marine ecosystems. This project will deliver the most comprehensive seagrass genome available globally.

The Impact
The availability of these sequences will provide a valuable resource for additional research in areas such as population genetics, environmental DNA (eDNA) analysis and genomics – all emerging components of marine ecosystem management. It has the potential to lead to the identification of genes that increase the efficiency of biosequestration. The project will also position IOMRC to build in-house capacity to develop world-class genomic resources.

MEALWORMS: TAKING A BITE OUT OF PLASTIC POLLUTION

UWA Contacts
Sasha Voss
Rob Atkin

Industry Contacts
Dan Stone (Woodside)

Image: T.molitor, the yellow mealworm

The Problem
Polystyrene is a persistent, non-biodegradable plastic that is accumulating at alarming rates on land and in rivers, lakes and oceans globally. The University of Western Australia with support from Woodside Energy Ltd is taking steps towards developing insect technology that will convert polystyrene waste into high value, sustainable protein products such as fertilisers and soil improvers. Preliminary studies suggest that Tenebrio molitor (yellow mealworms) are capable of degrading polystyrene via enzymatic processes in the larval gut. Additionally, there are other insect species that are known to readily digest other plastic types. However there is very little information on how this occurs, the efficacy of the process, and how this might be optimised to develop plastic-degrading technology.

The Process
Chemical analyses of larvae and insect frass (for desirable proteins and lipids, and undesirable metabolites of polystyrene) will be conducted, along with measurement of polystyrene to biomass conversion rates by Tenebrio molitor.

The Impact
This project has the potential to revolutionise our approach to managing plastic waste. In an environment where plastic waste is globally endemic, the ability to completely degrade various types of plastic would be groundbreaking. Successful project execution may lead to exploring mechanisms for polystyrene eradication and removal. Ideally, a prototype business model in which polystyrene could be converted into a high value protein product will be developed. In collaboration with Woodside Energy Ltd, a comprehensive roadmap for a dedicated research program going forward will be developed, plus a literature review informing future funding applications for the technology and associated processing facilities. This project capitalises on UWA's unique expertise in insect farming, soil science, novel animal feed development, AgTech engineering and resource economics. Further expansion of our capability in these disciplines will lead to additional government grant revenue, and higher degree research intake.

RAPID BAR CODING AND DNA SEQUENCING KIT

UWA Contacts
Parwinder Kaur
Marie-Lise Schlappy

Industry Contacts
Harvey Smith (Woodside)

Image: Parwinder Kaur

The Problem
To improve understanding of how marine growth accumulates on and around subsea equipment Woodside (in collaboration with the equipment provider) has placed an "Anti-Marine Growth Structure" (AMGS) on the seafloor with a number of equipment pieces. Using this structure they are interested to find out which marine animals might be responsible for the most significant growth and, in turn, how to improve future structure design and function. Using the DNA sequencing kit, we will be able to obtain the DNA of these animals when the AMGS is retrieved from the ocean.

The Process
Using the kits will allow only the DNA to be brought back to the laboratory at UWA for analysis, rather than the whole piece of equipment. If the proof of concept is made using the OceanWorks seed project, more kits could be purchased to investigate organisms on Woodside's oil and gas equipment, circumventing the need to bring animal samples back to the laboratory, which would be logistically more difficult and costly.

The Impact
The outcome for the initial DNA kits purchased will be a proof of concept that the DNA of problematic marine organisms can be collected on the vessel that retrieves equipment from the ocean. This is a marked advantage compared to bringing the whole equipment back or even samples to the laboratory, which is costly and time-consuming.

LOW COST UNDER WATER DATA ACQUISITION SYSTEM

UWA Contacts
Henning Mohr
Guido Wager

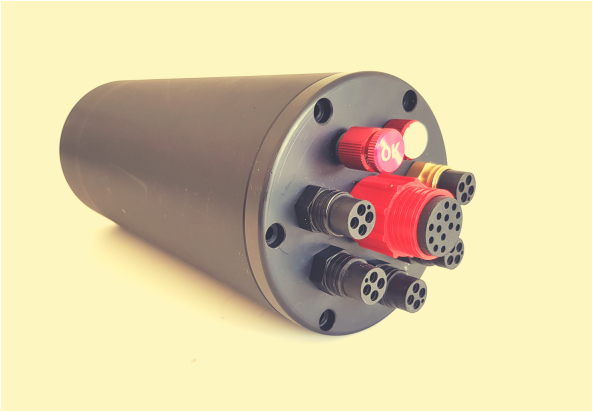

Image: U-DAQ

The Problem
Any offshore development would benefit from the collection of subsea measurements enabling the live-streaming of in-situ research data. Typically the measurements are collected and processed in an underwater data acquisition system (U-DAQ) that enable the transmission of the data to shore. Data acquisition systems used in industry are extremely expensive and affect significantly the budget of any research project leading to the need for more cost effective methods to record measurements in the offshore environment.

The Process
This project comprises the design development, implementation and testing of a low-cost underwater data acquisition system that is able to live-stream data recorded during offshore projects. The developed U-DAQ is capable of collecting measurements from multiple sensors such as load-cells, pressure sensors, IMUs etc. and send it via an umbilical to shore and then via wireless technology to the cloud. The proposed system is a necessity for any project that requires underwater data collection.

The Impact
In contrast to already commercially available systems, the proposed innovative U-DAQ is designed for cost effectiveness without compromising or neglecting the system reliability, precision, accuracy and reproducibility of data.

TESTING THE POTENTIAL FOR MARINE GROWTH TO DISRUPT VORTEX INDUCED VIBRATIONS ON LONG SPANS ON WOODSIDE PIPELINES

UWA Contacts
Hongwei An
Terry Griffiths

Industry Contacts
Nino Fogliani (Woodside)

Image: Marine Growth

The Problem
At present, evaluating the resonant behaviour and therefore remaining fatigue life of long pipeline spans to ensure that Vortex Induced Vibrations (VIV) cannot lead to failure, bearing a significant cost to offshore industries. The present engineering practice does not address the presence of marine growth on the pipe, nor its potential to disrupt VIV. However, recent research undertaken by UWA has studied a number of Woodside pipelines (Echo Yodel, Pluto flowlines) and identified a correlation between the extent of marine growth and the location of pipeline spans. In existing hydrodynamic research, marine growth is treated as longitudinally, temporally and circumferentially uniform in 'roughness'. However, recent collaborations between marine biologists and subsea engineers within the Indian Ocean Marine Research Centre have facilitated a greatly enhanced understanding of the nature and influence of marine growth on subsea structures. UWA are seeking to propose a significant programme of research into the influence of marine growth on hydrodynamic forces and propensity for VIV on subsea cables and pipelines

The Process
This project will collate existing Woodside pipeline data, extract selected example spans from the most recent available Remotely Operated Vehicle (ROV) port and starboard survey videos, characterise the extent of marine growth observed, and finally prepare a brief technical note considering the likelihood that the marine growth present on these spans has the potential to suppress VIV.

The Impact
This project will deliver a technical note providing information on the extent of marine growth on Woodside pipeline spans requiring regular or extensive engineering evaluation and an evaluation of the potential for the observed marine growth to suppress the formation of coherent vortex shedding. The note will be used to determine whether or not Woodside are likely to benefit from further research that would provide documented methods of accounting for marine growth in assessment of VIV propensity on spans.

DEVELOPING BETTER GUIDANCE ABOUT THE ROLE OF FIELD JOINTS IN INITIATING PIPELINE SCOUR FOR TRUNKLINES

UWA Contacts
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Terry Griffiths
Weidong Yao

Industry Contacts
Peter Fisher (SEA)
Kevin Wagland (INTECSEA)

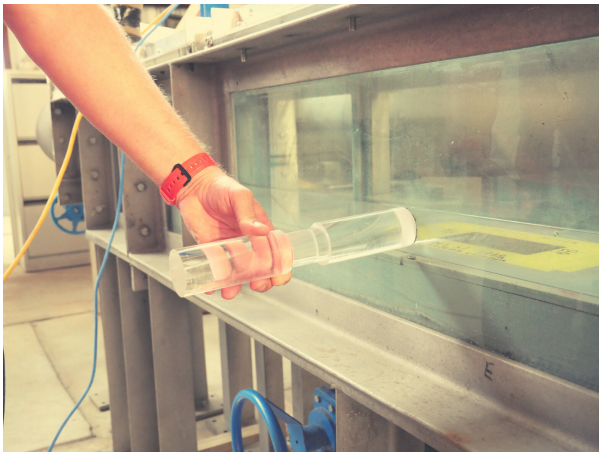


Image: Scale model of a field joint

The Problem
The STABLEpipe design guideline authored by UWA and published by DNV presents guidance on how to account for sediment mobility, scour and sedimentation in pipeline stability design. This guideline has been applied to offshore NWS pipeline engineering projects in recent years. A key learning from this guideline is that scour initiation points along the pipeline are critical to kick-starting the scour process, leading ultimately to pipeline lowering and improved stability. For concrete coated trunklines, field joints present natural locations for the onset of scour given the locally reduced diameter. Consequently, the embedment conditions at field joints prior to extreme design storm conditions is of great importance to the behaviour of the pipeline during the design storm event. Understanding and being able to predict the as-laid embedment condition and subsequent changes under ambient/non-extreme conditions is therefore of great interest.

The Process
This project will undertake experiments to assess the embedment at field joints resulting from scour episodes typical of ambient conditions. The work will be built on earlier research which has focused on assessing the scour initiation potential at field joints immediately following lay. The experiments will be undertaken in the Small O-Tube facility at UWA. An existing set of pipelines at UWA with joints that mimic those expected on concrete coated trunklines will be used – keeping costs low. The specific experiments will explore three different (relevant) joint geometries and four different ambient flow conditions (typical of ambient conditions offshore the NWS of Australia).

The Impact
Experiments will form a peer reviewed paper exploring scour initiation potential at field joints following pipeline lowering. The peer reviewed paper will then be submitted to DNV for consideration as an annex to the STABLEpipe guideline for application on future design projects.

CHALLENGES

KPI 2.2 Number of challenge sessions focused on Woodside strategic issues

The purpose of this KPI is to ensure there is an understanding of Woodside's business. This KPI is measured by the number of challenge sessions focused on Woodside strategic issues.

In 2019, 3 challenge sessions were run through OceanWorks, and all were on issues that originated through Woodside, and all involved Woodside employees in the delivery of the sessions.

Challenge sessions involve a member from industry sharing a problem they have encountered in their work to a group of UWA academics, who then discuss possible ways of developing a solution that could be implemented in Industry. Two sessions have led to research projects.

The satisfactory target for this KPI is two sessions annually. This target was set by the OWAGC in August 2019 and has been met.

POOR 1 SESSION	SATISFACTORY 2 SESSIONS	OUTSTANDING 4 SESSIONS

OVERVIEW OF SUBSEA ISSUES

Harvey Smith

This session covered the challenges faced with subsea production systems and structures that are put on the seabed. Specific areas discussed included: marine and calcareous growth, and Topside interfaces and protocols.

DO MEALWORMS BIODEGRADE POLYSTYRENE?

James Wheelan
Dan Stone

Industry produces a significant amount of polystyrene waste as part of construction and operations. Mealworms have been identified as potentially able to consume polystyrene and biodegrade it. This session proposed a study to demonstrate the feasibility of biological degradation of polystyrene waste using mealworms.

UPDATE: this has led to a prototype project with the School of Biological Sciences (UWA) that will commence in late 2019.

CAN WE MAKE A NOISELESS CHOKE-VALVE?

Ivan Yip
Dan Stone

As part of the Browse Development, there is a requirement to install subsea infrastructure (specifically choke valves) in the channel that will emit noise during operations. There is an opportunity to reduce or eliminate the noise by developing a Noiseless choke valve. A Noiseless Choke valve could avoid environmental monitoring costs and support the approval process

UPDATE: this has led to a project with Jeremy Leggoe (UWA) that will commence in early 2020.

RESEARCH

KPI 2.3 Quantity of research ideas being generated and investigated within OceanWorks

The purpose of this KPI is to measure the level of activity within OceanWorks. This KPI is measured by the total number of research projects across OceanWorks.

OceanWorks has a number of mechanisms for progressing research ideas, including prototypes, the Woodside RiverLab program, and internships. Woodside is regularly invited to propose research projects for each of these mechanisms, and to work with academics to deliver valuable outcomes.

In 2019, 48 different research projects were supported through OceanWorks, with 11 prototype projects, 13 internships, and 24 RiverLab projects. This was a significant increase on 2018 activity (15 projects).

The target for this KPI is 15 ideas annually. This target was set by the OWAGC in September 2019 and has been exceeded.

POOR	SATISFACTORY	OUTSTANDING
5 IDEAS	10 IDEAS	15 IDEAS

RESEARCH IN 2019

OceanWorks has 3 mechanisms for progressing research ideas; prototypes, internships, and the RiverLab program. Prototypes support small scale, innovative research projects with direct industry relevance. The Woodside RiverLab program supports year-long masters projects on industry-relevant research. Internships support student projects that can be completed in a 10-week period.

RELATIONSHIP

3.1 ENGAGEMENT

3.2 PROMOTION

3.3 AWARENESS

3.4 COMMUNICATIONS

OceanWorks aims to build collaboration between Woodside and UWA. The relationship between Woodside and UWA has consistently developed since OceanWorks' launch in 2016, and both organisations are continuously exploring ways to strengthen their internal networks and provide new opportunities for direct collaboration.

To assess the effectiveness of this collaboration, three KPIs have been introduced to monitor the number of engagement activities, the level of promotion of events and projects, and the awareness of the program outcomes and activities.

ENGAGEMENT

KPI 3.1 Number of Woodside/UWA Engagement Activities

The purpose of this KPI is to develop a broader Woodside Network by increasing the interaction between both organisations. It is measured by the number of Woodside/OceanWorks events per year.

Events are considered Engagement Activities if they involve both Woodside and UWA staff, and the event involves networking or collaborative activities.

In 2019 OceanWorks organised and supported 42 engagement activities that included a range of meetings, workshops, and outreach events.

The target for this KPI is 30 events annually. This target was set by the OWAGC in September 2019 and has been exceeded by 40%.

POOR	SATISFACTORY	OUTSTANDING
10 EVENTS	20 EVENTS	30 EVENTS

ACTIVITIES IN 2019

In 2019 the Engagement Activities organised by OceanWorks have focused on activities that bring together Woodside and UWA staff. The purpose of these activities is to provide opportunities for individuals from both organisations to build relationships and increase collaborative networking.

Notable Engagement Activities in 2019 included Challenge Sessions, Tech60 presentations, Woodside RiverLab seminars, SUT events, Offshore HUB workshops and meetings, and a number of outreach events including the Women of IOMRC Network, The Life Under Water STEAM Competition, and the Emerging Engineers Competition.

42
ENGAGEMENT ACTIVITIES

PROMOTION

KPI 3.2 Both Parties promote OceanWorks within their organisation as a tool for innovation and engagement.

The purpose of this KPI is to develop a broad Woodside Network. It is measured by the number of events/projects circulated within UWA, and the number of new points of contact made by UWA.

Invitations for events and information about projects are circulated by the OceanWorks Curator to academics and students within the UWA Oceans Graduate School and the Oceans Institute.

The first target for this KPI is 10 projects circulated annually. This target was set by the OWAGC in September 2019 and has been exceeded.

The second target for this KPI is 25 new points of contact made by UWA. This target was set by the OWAGC in September 2019 and has met the satisfactory target of 15 new points of contact.

POOR	SATISFACTORY	OUTSTANDING
2 EVENTS/PROJECTS CIRCULATED	5 EVENTS/PROJECTS CIRCULATED	10 EVENTS/PROJECTS CIRCULATED
POOR	SATISFACTORY	OUTSTANDING
5 POINTS OF CONTACT	15 POINTS OF CONTACT	25 POINTS OF CONTACT

24 OceanWorks events were circulated within UWA, including seminars by visiting academics, challenge sessions, and outreach events including the Women of IOMRC Network, Life Under Water Competition, and Future Engineers Program.

5 projects involving funding opportunities were circulated within UWA, including the summer and winter internships, the Woodside RiverLab program, and the prototyping fund.

15 new points of contact were made between UWA and Woodside in 2019. This included those who proposed new challenges (Dan Stone, Ivan Yip) and engaged with outreach activities (Lucia Zang and Lis-Marie Hunt).

AWARENESS

KPI 3.3 Both Parties are sufficiently aware of the activities of OceanWorks and Outcomes from Projects

The purpose of this KPI is to demonstrate commitment to the OceanWorks Project. This KPI is measured by the total number of news stories shared by OceanWorks per year.

Data is collected by the OceanWorks Communications Officer on stories shared through internal and external communications at UWA. Stories include posts on social media and other communications platforms that share information about OceanWorks activities.

In 2019 102 stories were shared on 5 different platforms, including Instagram, facebook, twitter, the OceanWorks Newsletter, and UWA News.

The target for this KPI is 10 stories annually. This target was set by the OWAGC in September 2019 and has been exceeded.

POOR	SATISFACTORY	OUTSTANDING
4 STORIES	6 STORIES	10 STORIES

STORIES IN 2019

External communications about OceanWorks activities predominately takes place across three social media platforms (Instagram, Twitter, and Facebook), the monthly newsletter, and UWA News. Across all social media platforms, 86 stories about OceanWorks events and projects were shared in 2019. The OceanWorks newsletter launched in October 2019 and is produced on a monthly basis; each newsletter shares 3 stories (research, student experience, and outreach). UWA News share stories that highlight new and innovative outcomes or engagement activities.

COMMUNICATIONS

A communication strategy is in development, aiming to clearly identify and segment OceanWorks audiences, delineate strategic objectives, and develop effective key messages to achieve these objectives.

Key internal and external communication tools have been mapped in order to identify a clear, efficient and effective process flow for content creation and delivery. This includes 3 new platforms launched 2019: the OceanWorks website, a monthly Newsletter, and expanded social media presence.

The communication strategy will capitalise on existing internal and external channels in order to increase awareness, engagement and promotion of OceanWorks activities. This includes stories appearing in Woodside Trunkline (Boosting Student Skills, appearing in Q4 2019).

2020 STRATEGY

In 2020, the effectiveness of the current communication strategy will be evaluated against the key objectives. Further improvements to communications to be explored in 2020 include investigating the value of LinkedIn, a review of social media strategy, improved usage of the OceanWorks space for communication, and additional marketing collateral for events.

WEBSITE

The OceanWorks website has been redesigned to be consistent with new UWA guidelines. The website provides information on the unique structure of OceanWorks, and is a central repository for the achievements of OceanWorks supported projects.

In 2020, further improvements will include a streamlined digital booking process for the OceanWorks lounge, archived Prototype and RiverLab Projects, and a promotional video to appear on the homepage.

NEWSLETTER

The OceanWorks newsletter launched in October 2019. This monthly publication contains a 'What's On' segment promoting upcoming events at OceanWorks, and 3 story segments covering recent news in Prototype Projects, Student Experience, and Outreach. The audience comprises internal UWA researchers in marine science, engineering and related fields, Woodside board members, and direct collaborators/ partners related to the monthly features.

In 2020, OceanWorks will include a thought leadership piece. OceanWorks will seek to grow the mailing list in 2020 to include more regular industry subscribers as well as community and outreach focus groups.

TWITTER

4300 impressions, 33 Followers, 27 tweets, 20 likes
OceanWorks Twitter account launched in September 2019. Twitter updates followers on events in the OceanWorks space, announces achievements by OceanWorks academics and students, retweets relevant news, and announces the monthly newsletter. In 2020, we will grow Twitter through increased social media signage in the OceanWorks space, and by encouraging activity among OceanWorks members.

INSTAGRAM

28,000 impressions, 1275 followers, 51 posts, 870 likes
OceanWorks Instagram showed steady growth over 2019, and has been used to showcase industry and community events in the OceanWorks space, as well as content generated by OceanWorks members, including PhD videos and student stories. With 1275 followers, the OceanWorks Instagram account reaches over 500 followers weekly. OceanWorks reaches a gender balanced audience (49% women, 51% men), with majority aged 18 – 34 years.

FACEBOOK

64 impressions, 5 followers, 5 posts, 7 likes
The OceanWorks facebook page launched in early October. With a small reach of only 60+ impressions to date, the Facebook strategy will be reviewed in 2020.

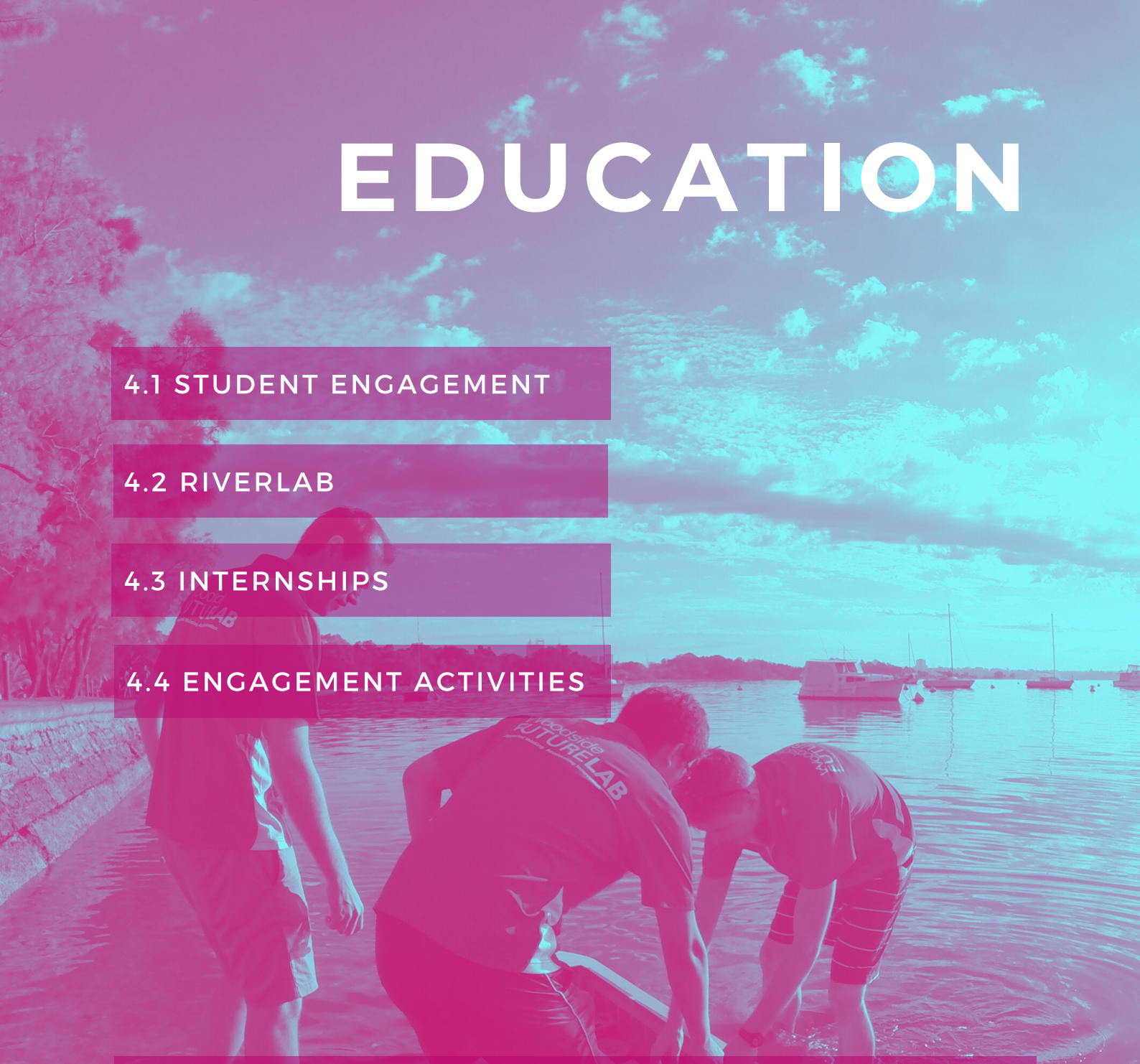
EDUCATION

4.1 STUDENT ENGAGEMENT

4.2 RIVERLAB

4.3 INTERNSHIPS

4.4 ENGAGEMENT ACTIVITIES



OceanWorks is committed to supporting the growth of the next generation of engineers through RiverLab, the Internship Program, and other student engagement activities. The educational activities run through OceanWorks focus on providing industry experience and opportunities to develop high level skills and training.

This KPI tracks the level of student engagement by tracking the number of students involved in RiverLab, the Internship program, and through other OceanWorks activities.

STUDENT ENGAGEMENT

KPI 4.1 The number of students involved in OceanWorks projects

The purpose of this KPI is to develop high quality graduates who are familiar with Woodside projects. This KPI is measured by the number of students engaged in RiverLab, internships, and in total across all OceanWorks activities.

The first target for this KPI is to engage 20 students through the RiverLab program. This target was set by the OWAGC in September 2019 and has been exceeded.

The second target for this KPI is to engage 10 students through the internship program. This target was set by the OWAGC in September 2019 and has been exceeded.

The third target for this KPI is to engage 100 students across all OceanWorks activities. This target was set by the OWAGC in September 2019 and has been exceeded.

POOR	SATISFACTORY	OUTSTANDING
5 RIVERLAB STUDENTS	10 RIVERLAB STUDENTS	20 RIVERLAB STUDENTS
0 INTERNSHIPS	4 INTERNSHIPS	10 INTERNSHIPS
10 STUDENTS ENGAGED	50 STUDENTS ENGAGED	100 STUDENTS ENGAGED

26 RIVERLAB STUDENTS

13 INTERNSHIPS

427 STUDENTS

RIVERLAB

RiverLab provides support for research based projects for students in the final year of their Masters of Professional Engineering. Each student works with a team of UWA academics and industry partners to conduct research involving the Swan River. At the end of their project students present the results of their project in a public forum that includes members of industry.

The activities of RiverLab are overseen by the RiverLab Advisory Panel. The Panel is responsible for approving funding to support projects.

In 2019 RiverLab supported 26 students who worked on 9 research projects.

Aidan Archer, a RiverLab student, was awarded the DN Foster Award. This is a national award presented to four graduates every two years.

In June a group of RiverLab students visited Woodside to present their research in a public seminar.

TESTING OF AN INNOVATIVE SELF-INSTALLING SPAR STRUCTURE

Dr Andrew Grime
Dr Lifen Chen
Mr Gavin Lane
Ms Siyu Liu
Mr Ryan Radameyer

Image: Preparing the Spar structure for calibration of the heave damping coefficient in advance of the Riverlab test program

The Project

Continuing from work completed by RiverLab students in 2018, the purpose of this project was to extend and enhance their outputs by drawing on lessons previously learned. This included undertaking the following key tasks:

- modify the existing model design to remove the deck structure (and hence high windage area) in order to limit the response to heave resulting from the incident wave field;
- modify the existing model design to change the internal mass distribution to better match the target mass moment of inertia properties;
- site selection – consider an alternate Swan River site which generates less onerous wave conditions;
- input data – create a software tool which correlates forecast and actual wind data at the Swan River inner dolphin pylon to measured wave conditions at the various Swan River sites;
- improve diffraction modelling outputs by considering the water motion inside the moon pool; and
- extend the previously developed coupled model of the Spar structure to consider various foundation options/mooring systems.

The experimental test campaign was a success and resulted in the collection of a significant data set which was used to correlate with numerically generated results. In addition, a re-usable foundation structure was developed which will be deployed in future Riverlab campaigns.

ASSESSING NOVEL NATURE-BASED SOLUTIONS FOR COASTAL FLOOD DEFENSE

Prof. Ryan Lowe
Dr. Marco Ghisalberti
Dr. Maryam Abdolahpour
Mr Jeffrey Kitson

Image: Artificial Seagrass mats (ASMs) are efficient in capturing sediments and this efficiency increases with mat shoot density. This image shows the start of the test. Image courtesy of Hannah Dawn.

The Project

Traditionally, engineering strategies to manage flood risk along coastlines have relied on 'hard' or 'gray' engineering infrastructure, such as seawalls and breakwaters, that often have numerous undesirable consequences on a coastal zone (e.g. damaging coastal ecosystems, disrupting natural coastal processes, shifting problems to other adjacent coastal regions, and devaluing coastal amenities, including aesthetics). There is a growing movement internationally to adopt new "green" or "hybrid" approaches that use natural features of a coastal ecosystem to provide equivalent coastal flood defense. This includes planting or restoration of aquatic vegetation (e.g. seagrasses and salt marsh) and use of natural or artificial reefs. Successful nature-based flood defense projects can thus protect coastlines while having numerous additional co-benefits such as enhancing coastal ecosystems, improving coastal water quality, providing habitat for marine species, and improving coastal aesthetics.

As part of Riverlab, this project will use the Swan River as a case study to investigate the feasibility of using nature-based approaches, such as large-scale planting of aquatic vegetation and/or artificial structures, to reduce coastal flooding risk. This is a multifaceted project incorporating experimental testing to assess how different approaches modify coastal waves and water levels, application of predictive models and ultimately field trials conducted along the Swan River foreshore.

IDENTIFICATION OF CONTROLS ON THE METABOLISM OF THE SWAN-CANNING ESTUARY USING HIGH-FREQUENCY DATA AND NUMERICAL MODELLING

Prof. Carolyn Oldham
A/Prof Matt Hipsey
Ms Amina Saeed

Image: The solar-powered buoy that that will provide the platform for the monitoring station

The Project

The research is a collaborative initiative between the Department of Biodoversity, Conversation and Attractions (DBCA) and the Riverlab at UWA, to create an Estuary Observatory, which aims to:

1. Use high temporal resolution field data to identify drivers and controls on the metabolism of the Swan-Canning estuary.
2. Improve the ability of the Swan-Canning Estuarine Response Model (SCERM) to predict ecosystem metabolism and estuarine health.

The project will establish a permanently moored station in the Swan-Canning River near the University of Western Australia. A solar-powered buoy will house high accuracy, high stability sensors for continuous high frequency monitoring of key parameters such as dissolved oxygen, chlorophyll a, salinity, photosynthetically active radiation (PAR), fluorescent dissolved organic matter (fDOM), temperature, wind speed and direction and solar radiation. The water quality sensors will be deployed at different water depths (i.e. surface, middle, and close to the sediments), while the meteorological sensors will be placed above the water line.

The high-frequency data will be telemetered through a 3G mobile network to a data server to allow real-time viewing. The high frequency data will allow calibration and validation of process modules within SCERM and the subsequent testing of drivers of estuary metabolism. Improved understanding and modelling capability of estuarine metabolism will facilitate management decisions to support the health of the Swan-Canning estuary.

RESEARCH ON COMPOSITE MATERIALS FOR OFFSHORE APPLICATIONS

Dr Mehrdad Kimiaei
Dr Mohamed Elchalakani
Mr Benjamin Donetta
Mr William Marshall
Mr Liam Van Der Westhuizen

Image: Underwater repair being carried out in a tank of water collected from Swan River

The Project

Steel members in offshore facilities are susceptible to corrosion and for aged facilities this process could eventually lead to non-compliant members or joints against existing codes. A possible solution for this problem is strengthening the non-compliant components by wrapping Fibre Reinforced Polymers (FRP) around the external surface of the corroded members or joints. A potential question about this technology is whether it is effective in marine or subsea conditions. In the study, a total of 60 tubular steel members were wrapped with FRP in air or underwater. Water from the Swan River was pumped into temporary pools for underwater testing. Later these were tested in the Structural Laboratory at UWA under different types of loading scenarios to understand and compare the performance of such repairs in different conditions. Loading of the specimens included concentric and eccentric axial compression as well as four-point bending. The test results revealed that the underwater repair performed equivalent to the conventional in air repair. Promising results from this study are encouraging future research on composite materials for offshore applications.

FIELD PERFORMANCE OF A NOVEL DYNAMICALLY INSTALLED ANCHOR IN THE SWAN RIVER

A/Prof. Muhammad Shazzad Hossain
Dr Shiaohuey Chow
Dr Youngho Kim
Mr Jeremiah Zhao
Mr Shane Rohan

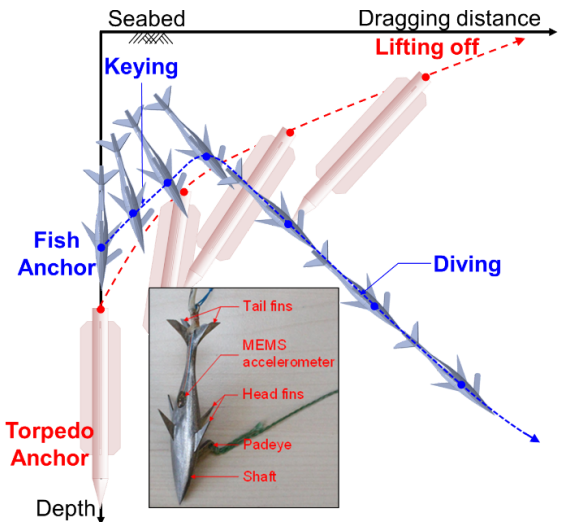


image Diving potential of dynamically installed anchors under operational loadings

The Project

This project aims to unlock the potential of a novel dynamically installed anchor. Dynamically installed anchors (DIAs) are the most recent type of anchoring solution providing a cost-effective alternative for mooring floating facilities in deep water clayey sediments. They are also being increasingly considered in shallow waters for temporary mooring of floating facilities and for mooring floating wind turbines. DIAs are installed by free-fall dropping through the water column and then penetrating into the seabed. This necessitates no external energy source and hence the installation method can be applied in any water depth.

A novel dynamically installed anchor, known as the fish anchor has been developed and patented at UWA tackling Australia's problematic calcareous seabed sediments. Through advanced centrifuge and numerical modelling, the fish anchor was observed to embed up to 60% higher and demonstrate much higher diving potential than other dynamically installed anchors in reconstituted calcareous silt. To confirm the field applicability of the fish anchor, it is the time to carry out some large scale or full scale tests in the field. This project aims to develop a field prototype fish anchor and asses its performance in the Swan River. This project will involve a team of two students, Jeremiah Zhao investigating the anchor installation and Shane Rohan investigating the capacity of the fish anchor.

EFFECT OF SURFACE WAVES ON OVERARM SWIMMING PERFORMANCE AND BEHAVIOUR

A/Prof Scott Draper
Mr Justin Geldard
Mr Xander Lim
Mr Benjamin Turner

Image: Testing at the UWA Wave Flume

The Project

Almost all open water swimming events (including the 10 km Swim Thru Perth race which has been undertaken 100 times in the Swan River) occur in the presence of surface waves. This characteristic is one of the factors which distinguishes open water swimming from pool swimming. Nevertheless, despite this difference very little research has been undertaken to investigate how surface waves influence swimming performance (i.e. speed) and behaviour (i.e. coordination). This project aims to undertake swimming experiments in the newly refurbished 54 m long wave flume at UWA's Shenton Park field station. Four elite swimmers will swim lengths of the flume whilst swimming both into and with regular waves of varying period and amplitude. The overarm motion of the swimmers will be captured to assess performance and behaviour, and it is hoped this will enable better understanding of this unique fluid-structure interaction problem.

The work is also being undertaken with the support of A/Prof. Grant Landers and colleagues from the School of Human Science (Exercise and Sport Science).

DEVELOPMENT OF A FREEFALL CONE PENETROMETER FOR OFFSHORE SITE INVESTIGATION

Dr Conleth O'Loughlin
Dr Shiaohuey Chow
Mr Vepulan Siritharan

Image: field deployment of FFP at Swan River

The Project

This project aims to unlock the potential of free-fall penetrometers as cost effective offshore site investigation tool. Free-fall penetrometers are instrumented projectiles that are deployed by allowing them to free fall and embed into the target sediment. Compared to the conventional approach of using a large survey vessel and a mechanical system for pushing a penetrometer into the seabed, free-fall penetrometers offer a cheaper and quicker way to survey the seabed, with potentially equal accuracy if the tools are designed and interpreted correctly.

A prototype free-fall cone penetrometer (FFP) has been developed at the Centre of Offshore Foundation Systems, UWA. This project will further optimise the design of the FFP, upgrade the instrumentation of the FFP, assess the performance of the new FFP, and validate the FFP interpretation method by conducting field trials in the Swan River.

MOORING OF WAVE ENERGY SYSTEM USING SUCTION CASSION

Dr Dirk Rijnsdorp
Dr Jana Orszaghova
Dr Hugh Wolgamot
Dr Raffaele Ragni
Dr Shiaohuey Chow
Mr Brennen Thong
Mr Daniel Ross
Ms Mimi Seng

Image: In situ soil sampling at Como

The Project

This project will build upon the recently completed Woodside Riverlab project on 'Studying mooring for wave energy system using scaled field trials'. The Swan River will be utilised as a model wave basin to investigate the performance of a model wave energy system taut-moored by a suction caisson in sand. The project will involve the following multidisciplinary scopes:

- Measuring and predicting wave climate in Swan River
- Design and response of the resonant floating oscillator and its mooring system
- Installation and performance of suction caisson under environmental loading

A TRAWLER-STEERING MECHANISM BASED ON TOW-POINT ADJUSTMENT FOR EFFICIENT MITIGATION OF SIDE-WIND LOADS: MODEL EXPERIMENTS IN THE SWAN RIVER

Mr Andrew Welsh (ECU)
Dr Cheslav Balash (ECU)
A/Prof.Scott Draper

Image: testing of model in the Swan River

The Project

Prawn trawlers operate at ~3 knots and have an inefficient low aspect-ratio keel, so unlike yachts, they do not efficiently generate side forces (with application of the rudder) when there is a need to resist side-wind loading. Furthermore, the rudder force, which produces the turning moment for the necessary angle of yaw and desired keel side force, is an undesirable side force as it acts in the direction of the wind. A pilot study has been conducted jointly by Edith Cowan University (ECU) and UWA to assess the potential benefits of adjusting the location of the tow points during the side-wind loading situation. Specifically, experiments with a self-propelled trawler model were conducted on the Swan River.

The challenge was to measure leeway angle, side force, and tow-force reduction for a range of rudder and tow-point adjustment scenarios. Preliminary analysis suggest that the tow-point adjustment may have a substantial energy-saving benefit, but further experiment refinement, data collection, and analysis is required to conclusively test the hypothesis and to take the concept to the next phase of development.

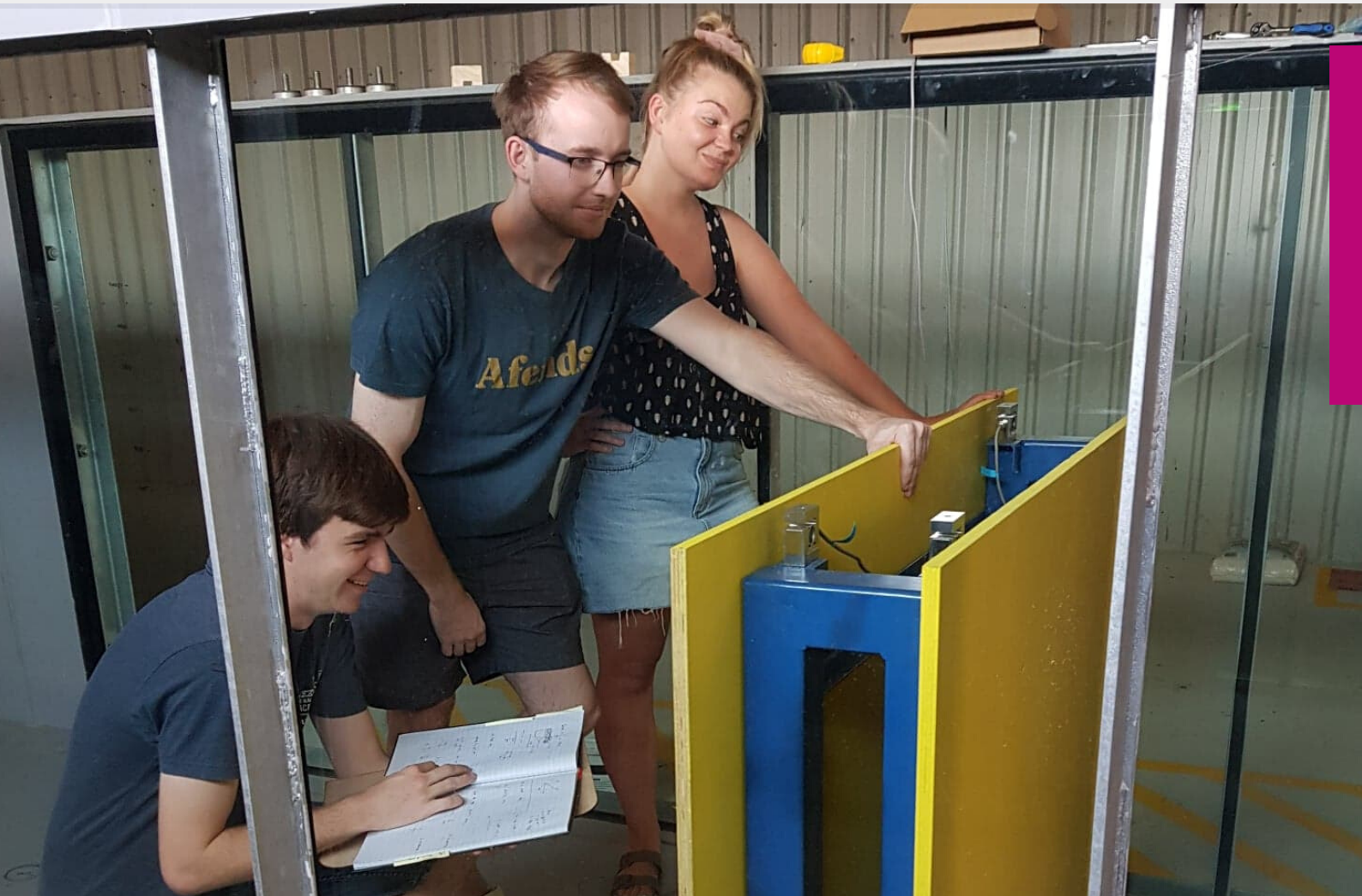
INTERNSHIPS

The OceanWorks Internship program brings high achieving engineering students to UWA to work on a 10-week OceanWorks research project.

in 2019 OceanWorks introduced its international internship program over the winter break, and welcomed 6 interns from Texas A&M, The University of Bologna, Dalian University of Technology, and Oxford University, and MIT to work on a research project for a 10 week period.

The students were supervised by UWA academics, and presented their research at a public seminar in August 2019.

In December 2019 OceanWorks welcomed 7 local interns to the OceanWorks summer internship program. The students will work with UWA academics on a research project, and will present their work at a public seminar in February 2020.



WINTER INTERNSHIPS

Harry Simpson
Oxford University
supervised by A/Prof Scott Draper

Investigating extreme waves off the coast of Albany, WA

This project investigates data from a wave buoy moored approximately 1km off the coast of Torbay, Albany. The buoy was deployed primarily to measure the wave resources in Torbay so as to inform developers of wave energy devices. However, over the past year this buoy has measured some very large waves, including a 13 m high wave in July 2018. Extreme or Freak waves occur when the largest wave in a record is greater than twice the significant wave height, which is defined as the average of the top third wave heights. These waves can be rare and seem unpredictable, therefore a better understanding of them is important. The time series of buoy motions from thirteen hours in July 2018 has been analysed to interrogate the characteristics of the largest waves. This analysis has been combined with a cross-analysis of extreme wave occurrence and parameters describing the wave spectra for an entire year of data. The quality of the data was also investigated by comparing the buoy data to data from an AWAC deployed at a different time, but similar location.

Di Mu
Dalian University of Technology
supervised by Dr Lifen Cheng

Numerical investigation of wave-wind interaction using OpenFOAM

Though infrequent, tropical cyclones have arguably been the most significant weather hazard in coastal areas. With the growth of mega-cities along the coastlines in the tropics, the volume of trade shipped by sea and the exploitation of offshore oil and gas in areas affected by severe tropical storms, it is clear that improved understanding of the physical processes in such storms would be of major scientific and societal concern. This work will investigate the local interaction of extreme waves and tropical cyclone winds with using numerical simulations based on the well-known CFD code, OpenFOAM. The structure and kinematics of the extreme wave events in presence of wind will be explored.

Ragini Gogoi
Texas A&M
supervised by Phil Watson

Numerical modelling of suction caissons in sand

Bucket foundations have been used in the offshore oil and gas industry for over 20 years, but to date have not had extensive application for offshore renewables. They represent a viable solution for the foundations of offshore windfarms, which are gaining momentum as an alternate energy source worldwide, but due to different design considerations (such as the proportionally smaller self-weight of offshore wind turbines) require new research to support their use. COFS have been heavily involved in such studies, with various projects completed and other ongoing. The work undertaken during this internship has used numerical analysis to look at the response of the bucket foundations under monotonic uplift in sand. This has involved the development of a fully coupled model, to explore the effect of different drainage conditions on uplift resistance. Parametric studies have been undertaken, and the results compared to experimental results obtained in the UWA centrifuge – leading to come interesting findings.

Noor Laham
University of Bologna
supervised by Phil Watson

Investigating strength changes in marine clays

Soil undrained strength is a parameter that governs design of many types of subsea infrastructure, and investigating the changes of the strength on marine clays is therefore valuable. A series of laboratory tests, on Gulf of Mexico clay samples at different OCRs, is being conducted using a T-bar penetrometer. These tests involve moving the T-bar at different cyclic amplitudes in order to quantify the effects of OCR on the steady-state strength and assess effects of subsequent larger cyclic amplitude on the small cyclic amplitude steady state strength. Understanding these effects will lead to improvements in offshore infrastructure design such as SCR-soil interaction.

Jamie Rose
Veronica LaBelle
MIT
supervised by Ryan Lowe

Developing a Low-Cost Data Logger for Coral Reef Hydrodynamics

With more rapidly successive bleaching events in coral reefs around the world, it's imperative to track and understand the hydrodynamics that directly affect well-being of these reefs. Currently, data loggers that record aspects like pressure, temperature, and flow can cost anywhere between $3,000-40,000, and in lower income countries like Mauritius, these instruments can be lost, stolen, or damaged, posing a significant cost sink. A low-cost data logger will facilitate accessibility to hydrodynamic and coastal erosion research projects in low-income countries. It would also allow for leading oceanographic institutions like UWA to record more rigorous and comprehensive data sets without taking on the large financial risk associated with expensive oceanographic equipment.

This project developed a prototype for a low-cost deployable data logger to sense and record pressure, temperature, and flow data around coral reefs. We will compare the data between the testing of our logger (less than $500) with that of existing loggers and show the data quality provided by our lower cost models.

SUMMER INTERNSHIPS

Kelly Hawes
supervised by Nicole Jones, Matt Rayson, and Greg Ivey

Vertical mixing adjacent to Scott Reef
Quantifying the physical mechanisms responsible for the vertical fluxes of heat, nutrients, pCO2 and other tracers is necessary for understanding the vulnerability of coral reef systems to changing ocean conditions and global warming. The offshore coral atoll system of North and South Scott Reef, has a 2-3 km wide channel between the atolls where internal hydraulic jumps likely drive the vertical mixing. Quantifying the extent of the vertical mixing is vital to understanding the exchange of offshore water with the lagoon atolls. For example, decreased vertical mixing would result in cooler water being transported into the lagoon from depth. This project will use microstructure turbulence measurements to quantify the vertical mixing as a function of time and depth and relate it to the internal hydraulic jump dynamics. Furthermore, the role of vertical mixing in the delivery of water to the lagoon will be quantified.


Kelly Hawes

Austin Sheard
supervised by Nicole Jones, Matt Rayson, and Greg Ivey

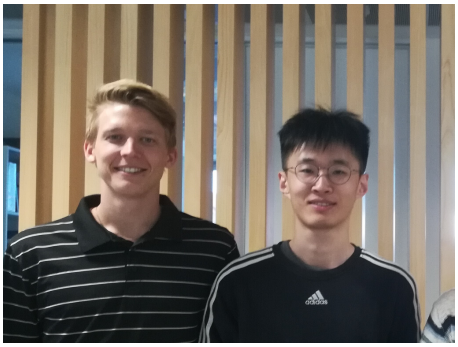
Near-bed visibility on the North West Shelf
The North West Shelf (NWS) is an area of expanding human development for numerous industries whom require knowledge of underwater visibility in order to plan and execute subsea operations e.g., using ROVs. Understanding the processes that control sediment on the continental shelf is critical to the prediction of near-bed visibility. Data from ocean moorings deployed near Scott Reef on the NWS indicate that internal waves play a significant role in increasing turbidity and can resuspend fine particles >10 m upwards that can last up to 6 hours. This project will use a variety of existing in situ data sources to relate acoustic echo intensity to sediment resuspension and internal wave properties. Quantifying visibility from acoustic measurements will allow us to identify potential drivers of poor visibility in the existing data record and the potential to predict low-visibility periods. This work will be beneficial to various offshore industries, particularly oil and gas operators.


Austin Sheard

David Gelle
Yucheng Feng
supervised by Phil Watson

Pile Aging and life extension of facilities

This project involves research related to pile aging. In early 2019, discussions started with Shell Brunei over the potential for pile aging effects to justify an increase in pile capacity, which could benefit life extension of existing facilities. Initial desk top studies showed this was worth further research, and steps have been taken to source soil samples for testing. This project involves examining the response at an element level, using shear box apparatus that has been modified to improve the resolution of measurements, and tests involving aging via small scale pile tests that are being performed in a pressure chamber. Work is also ongoing to identify a field site suitable for larger scale testing.



David Gelle (left) and Yucheng Feng (right)

Navin Latchman

Navin Latchman
supervised by Zach Aman

Validation of Gas Dominant Hydrate Model

The ever increasing demand in oil and gas has highlighted the need for more effective extraction methods to reduce risk, environmental and economical strain. One of the major risks associated with subsea resource extraction entertains the build up of hydrate, which can eventually form a blockage or a hydrate plug.

The easiest way to ensure no blockage occurs is to eliminate the possibility of hydrate formation, this can be done a multitude of ways. Nowadays it is essentially that a software modelled replica can be produced for feasibility studies, this means flow assurance softwares such as OLGA must be able to replicate a variety of scenarios involving hydrate deposition. There currently exists a hydrate kinetics model plugin (CSMHYK) which effectively predicts hydrate behaviour in oil dominant flow, however currently the gas dominant hydrate plugin is under development.

The CSIRO laboratory in Perth houses a HYJUMP flow loop which is designed to mimic the geometry of a subsea jumper. Gas condensate experiments have been conducted in this flow loop to determine both fluid and hydrate behaviour. The objective of my project is to create a flow assurance model through OLGA and test the validity of the developing gas hydrate plugin against the experimental data.

James Dingley
supervised by Hugh Wolgamot, Wenhua Zhao, and Ian Milne

Floating Vessels and nonlinear dynamics
Vessels sometimes need to moor close to one another in the ocean. In this scenario, fluid in the small gap between vessels may undergo large resonant motions when driven by waves of the appropriate frequency. Structurally, the problem can be studied by simplifying the system to one fixed body connected to a floating body by a nonlinear spring with particular characteristics (stiff when close together and soft when far apart). The combination of a small gap between vessels and nonlinear spring leads to interesting dynamic responses of the system, as has been revealed by some existing numerical modelling. This project will design and test a model of this system in the new 50m wave flume at Shenton Park. This will require design of the model, selection of measurement systems, selection of test cases, conducting and analysing experiments. The project combines fascinating nonlinear dynamics with real-world applications to ocean engineering problems.

James Dingley

Ryan Malone
supervised by Phil Watson

SMART Cables
This project involves building the case for combining science into future subsea telecom cables. This builds on recent industry engagement, and the primary task is to build a business case to encourage further development in this area. This will include engagement with potential stakeholders. In parallel, the project will engage a local startup (Terra15) and will undertake an initial testing programme using the UWA wave flume to investigate the potential for monitoring wave height from subsea cables.

Ryan Malone

STUDENT ENGAGEMENT ACTIVITIES

In addition to Woodside RiverLab and the OceanWorks Internship Program, OceanWorks supports a number of student engagement activities that aim to increase the skills of students and provide them with more industry experience.

In 2019 the activities supported were selected by the OWAGC, who approved funding for activities that were identified as valuable for students. Key activities supported in 2019 include the Oceans Leadership Summit, Hackweek, AMSA Conference, the Perth Science Festival, and the OGS Student Society, and the SUT site visit.

Students who participate in these events are provided with information about OceanWorks and the collaboration between UWA and Woodside. Following the competition of the activities feedback is obtained from students on the value of the activities. This feedback is then presented to the OWAGC.

Oceans Leadership Summit

In October 2019 OceanWorks supported Justin Geldard and Carly Portch, two PhD students from UWA, to attend the Oceans Youth Leadership Summit in Norway, and to visit University of Bergen and Norwegian University of Science and Technology.

The students were 2 of 100 youth selected to participate in the summit from over 1000 applicants. The trip allowed the students to widen their own networks, to promote the work done through OceanWorks, and to spark new opportunities for collaboration and interaction.

"Everyone has a role to play in protecting our oceans. By promoting this point of view and by sharing ownership of the challenge, I think it's possible to maximise awareness and motivation towards making positive sustainable changes."

- Justin Geldard

Ocean Hackweek

Ocean Hackweek is a multiple days hackthon organised by the eScience Institute of the University of Washingon. The Hackweek aims to foster the exchange of ideas in research and promote effective computation analysis using Oceanographic data. The Hackweek aims to provide informal peer-learning opportunity within applied computer sciences and is based on three core components: tutorials on state-of-the-art methodologies, peer-learning and on-site work in a collaborative environment.

Themes for 2019 included spatial statistics and geospatial mapping tools, machine learning methods and tools, large-scale data processing frameworks, data visualization tools, open source Python tools, ocean data. OceanWorks supported Nery Cont Neto, UWA PhD student, to attend the Hackweek. Nery is now planing to organise a local hackweek in Perth in 2020.

"The tools and knowledge obtained during the week were extremely valuable for my PhD experience. It also helped me shape future career goals, make contacts within national agencies and mingle with other scientists and students from across the globe."

- Nery Conti Neto

SUT Site Visit

OceanWorks provided support for 5 PhD students to participate in the SUT SubCon, ACEPT, and Farstad Site visits. The visit allowed students to develop their professional networks and to get experiences with local oil and gas operators.

In their report on the project the students noted that the experience was valuable and provided a new perspective on what local subsea technology companies are currently focusing on. Students noted the networking opportunities the site visit provided and thanked OceanWorks for its support.

"This was a very valuable experience during which I learnt what it means to be an Oil and Gas plant operator, I was given the chance to try offshore simulators and I heard the passionate experience of the CEO of Subcon and how he created a business for artificial reefs. It has not only been a very enjoyable day but I discovered facilities that I did not know about before, I increased my knowledge on practical skills I had not yet come across and engaged with very interesting people. I really hope OceanWorks will consider sponsoring similar events in the future."

- Nicole Fiumana

AMSA Conference

OceanWorks supported 4 PhD students to attend the Australian Marine Science Association Conference in Fremantle in July 2019. The Conference provided networking and professional development opportunities for the students.

One students, Lucy Arrowsmith, was awarded the Peter Holloway Prixe for Best Oral Presentation in Oceanography for her presentation at the conference.

"We were able to attend a wide variety of presentations from researchers throughout Australia which helped us to broaden our knowledge base, network with potential collaborators, and encouraged interdisciplinary discussions. This was also a valuable opportunity for us to gain presentation and public speaking experience, which was demonstrated when Lucy Arrowsmith was awarded the Peter Holloway prize for best oral presentation in Oceanography! We greatly appreciate the support from OceanWorks and we hope that this funding can continue to be provided to students in the future as this was an incredibly valuable experience"

- Lucy Arrowsmith

OUTREACH

5.1 OUTREACH

5.2 OUTREACH COMMUNICATIONS

OceanWorks recognises that diversity and communication are vital ingredients for innovative engineering. A number of targeted programs have been created to address the need for greater gender diversity in engineering. These activities target students in primary and secondary school, as well as university students and professional engineers.

Two KPIs have been implemented to track both the outreach activities of OceanWorks, and the communications associated with these outreach programs.

OUTREACH

KPI 4.1 To support programs that will increase inclusion and diversity within engineering and have a long term impact on the Industry

The purpose of this KPI is to develop a broad Woodside Network. This KPI is measured by the number of projects/programs supported with active OceanWorks participation.

In 2019 6 programs and 1 project were supported through OceanWorks. These programs/projects focused on increasing inclusion and diversity through STEM based activities for specific groups.

The programs supported this year targeted a range of participants - from primary school students who are beginning to learn about engineering, to academics and engineers working in industry.

The target for this KPI is 3 programs annually. This target was set by the OWAGC in September 2019 and has been exceeded - in 2019 7 programs/projects were delivered.

POOR	SATISFACTORY	OUTSTANDING
1 PROJECT	2 PROJECTS	3 PROJECTS

PROJECTS

Creating Inclusive Engineering Classrooms
A/Prof. Sally Male, Chair in Engineering Education, UWA
Dr.Melissa Marinelli, Research Fellow, UWA
The aim of the 'Creating Gender Inclusive Classes' research project was to investigate and enhance gender inclusivity in student teamwork in engineering classes at UWA. The project sought to translate into practice the research on how educators can support inclusive student teamwork in their teaching units. The project involved establishing baseline data, developing resources for educators, delivering a workshop, and measuring and assessing changes. OceanWorks provided $8000 in funding to support Dr.Melissa Marinelli's appointment.

As a result of this project a selection of engineering unit coordinators at UWA committing to implementing changes to their teaching units to ensure the teamwork conducted in their classes are more inclusive. In 2020 the workshop developed for this project will become available to all UWA Engineering and Mathematical Sciences (EMS) teaching staff. In addition to this Melissa Marinelli will engage with other Australian universities, and will deliver a paper on the research from this project at the Australian Association for Engineering Education Conference (December 2019), and the Research in Engineering Education Symposium (July 2020).

CREATING INCLUSIVE CLASSROOMS

PROJECT OUTCOMES

BASELINE DATA

Data was collected on team framework, roles, experience, assessment and evaluation, via student surveys and staff interviews.

Outcome: student teamwork experiences and outcomes in engineering and computer science at UWA are gendered. In particular:

Team Roles

- Gender segregation of roles within student teams are common but not often observed by teaching staff.
- Gendered difference in students' perceived i) freedom to choose a role, and ii) exclusion from technical roles exists.

Teamwork Experience

- Gender not perceived to influence students' teamwork experiences.
- Gender exclusion is seen as a 'workplace, not university, issue'.
  - Survey data: significant gender difference in feelings of inclusion (n=63, p=0.016) and respect (n=63, p=0.042) within student teams.
  - Female students perceived negative impact of gender on teamwork experiences (n=63, p-0.002).

"My knowledge was belittled, and my opinions were disregarded" - Female survey participant)

Teaching staff do not consider gender to be an influence on student teamwork

- Little awareness of gender when establishing, facilitating or assessing student teamwork.
- Gender exclusion is not a priority issue.
- 'International students / English language' perceived to be more pertinent.

COMMITTMENT AND ACTION

Teaching Staff were encouraged to commit to enacting changes during the workshops delivered through the project.

Outcome: Commitment to and action of a range of inclusive practices by teaching staff including:

Team Roles

- Rotation of team roles.
- All team members perform technical work.
- Refocusing students on learning outcomes rather than deliverable.

Teamwork Experience

- Use of team contracts.
- Use of student reflection to monitor student teamwork dynamics and contributions.
- Involving alumni to give context to teamwork.
- Dissemination of workshop information to teaching staff.

Assessment & Evaluation

- Explicit listing of student contributions.
- Ensuring all students have opportunity to perform technical work elements and report these in assessment submissions.

CHALLENGES

Engagement: Gender exclusion is not perceived to be a priority issue.

Lack of time: a barrier to engagement and implementation.

Measuring impact: impact is gradual and cumulative. Best assessed with a longitudinal sample.

PROGRAMS

The outreach programs supported this year focused on increasing gender inclusion and diversity within engineering. The programs specifically targeted women and non-binary individuals within four key groups: primary school students, high school students, university students, and engineers working in industry. For each group key issues were identified, and each activity in the outreach program was designed to help address the identified issues. For primary and high school school students, the key issue was breaking stereotypes around what engineering is and who can be an engineer. For university students and engineers working in industry the focus was providing career and networking support.

Primary School

Demistifying Engineering
Breaking Stereotypes About Engineers

Life Under Water STEAM Competition
In collaboration with Presbyterian Ladies College and the UWA Girls in Engineering competition, OceanWorks supported the inaugural Life Under Water STEAM (Science Technology Engineering Art Maths) Competition. The competition was open to female students in year 5 and asked them to create a piece of art celebrating marine biodiversity in the oceans based on research they conducted. At the awards ceremony a current PhD student, Sara Hajbane spoke about her career into engineering. Three art pieces were selected by a panel of judges to be displayed in OceanWorks, with the winning design to be produced on a Keep-Cup.

School Visits
In 2019 OceanWorks hosted 2 school visits. In total 130 primary school students visited OceanWorks and toured the Centrifuge and Gliders Lab. Current female PhD students and academics delivered short presentations to the students about their research and career paths, and an interactive workshop was provided by UWA's Robogals. The schools involved in 2019 were Presbyterian Ladies College, Coolbinia Primary School, and Our Lady of Fatima Primary School.

Image (left) winner of the Life Under Water Art Competition receiving anaward from Jan Flynn (Woodside), November 2019.
Image (right) School Visit to OceanWorks - students examine marine corals during an interactive session with Di McClean, May 2019.


Image (left) Emerging Engineers Competition Finals. Image right students working on the Future Engineers Program

High School

Deeper Understanding of Engineering and Career Paths
Confidence working on real-world Engineering Projects

Emerging Engineers Competition
Developed in partnership with UWA Girls in Engineering, the inaugural Emerging Engineers Competition offered an opportunity for female high school students to work on a real problem in marine engineering today. Themed on biofouling, the unwanted growth of marine life on submerged manmade structures, this is a challenging, multidisciplinary problem affecting many offshore industries globally.

Over 50 girls across Years 7 – 11 participated in this competition, researching, developing and refining innovative antifouling solutions over 2 terms. 8 shortlisted teams attended the Final Celebration Night hosted by UWA OceanWorks at the Indian Ocean Marine Research Centre where they pitched their solutions live in front of experts from industry and academia.

Future Engineers Program
The Future Engineers Program is a free Science Technology Engineering Maths (STEM) program for 50 female students in years 8-12. The program is run by Women in Subsea Engineering, and in 2019 OceanWorks was a sponsor of the program. As part of the program OceanWorks hosted students for a lunch and learn with academics and PhD students, provided a tour of the Gliders Lab, hosted career talks with 3 PhD students, and facilitated an interactive science communications workshop. OceanWorks also hosted the awards ceremony and provided operational support throughout the competition.

Image (left) Women in Engineering Mentor Program - welcome breakfast for mentors and mentees.. Image (right) Women of IOMRC Network at the September workshop with Vanessa Vershaw

University

Awareness of diverse career paths
Access to professional networks

Women in Engineering
CML Mentoring Program

In 2019 OceanWorks sponsored the Women in Engineering Program. The program is organised through the UWA Career Mentor Link and provides mentoring and networking opportunities for female engineering students at UWA.

The Women in Engineering Program;

- Pairs 30 - 40 students with mentors working in the industry
- Hosts networking and educational events annually
- Recruits Mentors from various engineering companies in Perth, including Woodside.

One of OceanWork's goals is to create high quality broadly educated engineers. By supporting female engineering students in the transition from university to industry, and providing them with a network of contacts within the industry, this project can help achieve that goal.

Industry

Opportunities for career development
Increased professional networks

Women of IOMRC Network

The Women of IOMRC Network provides career and networking opportunities for the women working in AIMS, CSIRO, and UWA OGS, and aims to increase the amount of collaboration between these organisations. In 2019 the Network hosted 6 events, including morning teas, conversations with VC Dawn Freshwater and Peter Veth of the Oceans Institute, a family movie night of the documentary 2040, and 2 workshops (Dealing with Difficult Behaviours, and Sex: Feminism and the Inclusion Revolution).

A steering committee has been established to oversee the activities of the network. Members from all organisations involved are represented on the committee. Male champions from all organisations have also been appointed to promote initiatives for gender inclusion within each organisation.

OUTREACH COMMUNICATIONS

KPI 4.2 To increase community awareness of OceanWorks through outreach activities and communications

The purpose of this KPI is to develop a broad Woodside Network. This KPI is measured by the number of stories about Outreach activities shared. Stories are shared by the OceanWorks Communications Officer with internal and external networks.

In 2019 4 news stories about Outreach activities were shared through internal and external networks.

The stories shared were: Life Under Water Art Competition, Emerging Engineers Competition, and the Oceans Leadership Summit.

The target for this KPI is 3 stories annually. This target was set by the OWAGC in September 2019 and has been exceeded this year.

POOR	SATISFACTORY	OUTSTANDING
1 STORY	2 STORIES	3 STORIES

STORIES

Girls rise to real world challenges with Emerging Engineers Competition
Shared August 2019, UWA News, ECHO Community News, and Woodside Trunkline
This story featured the winning team, Ballajura Community College, of the OceanWorks Emerging Engineers Competition and highlighted the collaboration between UWA and Woodside Energy.

The full story can be read at: http://www.news.uwa.edu.au/2019082711569/students/girls-rise-real-world-challenges-emerging-engineers-competition

Ocean Youth Leadership Summit in Norway chance to share ideas for Carly and Justin
Shared October 2019, UWA News
This story featured two PhD students from the Oceans Graduate School, Carly Porch and Justin Gelard, who were selected to participate in the Oceans Leadership Summit in Norway. The students were supported by OceanWorks.

The full story can be read at http://www.news.uwa.edu.au/2019102211683/international/ ocean-youth-leadership-summit-norway-beckons-carly-and-justin

UWA teams up with PLC Primary to celebrate Life Below Water
Shared November 2019, UWA News
This story featured the OceanWorks Life Under Water STEAM Competition and showcased the winning artwork.

The full story can be read at:
http://www.news.uwa.edu.au/2019112711743/outreach/ uwa-teams-plc-primary-celebrate-life-below-water

Ocean Glider Discovery Tour
This story featured in the December 2019 Newsletter covering a tour in the UWA Ocean Glider lab with over 60 Year 5 and 6 students from Coolbinia Primary School and Our Lady of Fatima School.

The full story can be read at:
https://us20.campaign-archive.com/?e=[UNIQID]&u=9db309be227b6ccf5f2af8053&id=8ce08f1e74