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Hands on Science to communicate innovations in  
research – engaging the public in coastal wave  
hazard measurements to inform management activities

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## DOCUMENT DATA SHEET

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<b>ABSTRACT</b>  Rising sea level is increasing the flood hazard from sea defence overtopping. New coastal schemes therefore need to be cost-effective and future-proofed. WireWall, with its portable, low cost measurement technology, is a system that can collect overtopping velocities and volumes to inform new scheme design and validate flood forecasting systems. Whilst the application of technology is important, it is equally vital that the scientific community actively engage with the public to raise awareness and understanding of coastal defence initiatives. To engage the public in understanding coastal hazard, how it is managed and how new advances in research informs management decisions, a portable demonstration model of the WireWall field rig has been developed. The tool is hands on, eye catching and user-friendly; and showcases new advances in technology to support coastal flood risk management thus educating the coastal community about changing hazard to promote public preparedness. This tool has successfully initiated in situ engagement between the public, coastal practitioners and researchers to develop support for a new scheme being planned at the WireWall study site. The future wellbeing of coastal communities depends on clear communication of new research that is making sense of changing seas. Here a methodology is presented that achieves just that. The communication facilitated through the design approach used to develop this tool, has turned knowledge and technological innovations into accessible information for government, business and the public.	
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## 1. Introduction

It is paramount that societies are informed on environmental risks that influence their well-being (de Juan *et al.*, 2018) and that the gap between science and policy is bridged (Snoeijs-Leijonmalm *et al.*, 2017). To achieve this science needs to be better integrated into society (Snoeijs-Leijonmalm *et al.*, 2017) which can be achieved in some degree by recognising the importance of public engagement (Horney *et al.*, 2016; MacAskill, 2019). Here we demonstrate a method to achieve this for coastal flood risk management.

The impact of rising sea level on the flood hazard from sea defence overtopping means new coastal schemes need to be implemented in a cost-effective and future-proofed way (Brown *et al.*, 2018b). WireWall, with its portable, low cost measurement technology, is a system that can collect overtopping data to inform the design of new coastal schemes so they can do just that (Brown *et al.*, 2018b; Witze, 2019). Whilst the application of technology is important, it is equally vital that the scientific community actively engage with the public to raise awareness and understanding of coastal defence initiatives (Areizaga *et al.*, 2012; Stilgoe, Lock and Wilsdon, 2014; Carapuço *et al.*, 2017). The importance of public engagement was highlighted by the House of Commons Science and Technology Committee (Creasy, Dowd and Stringer, 2017). Furthermore Daniel Pham (2016) states that public engagement is key for the future of science research. *Even though the societal impact of the science community's public engagement has been difficult to measure, available studies show a general positive correlation between high-quality community engagement and positive public attitudes towards science research (Pham, 2016).*

In order to engage the public in understanding coastal hazard, how it is managed and how new advances in research informs management decisions, it is important to use creative channels of communication that easily capture the audience's attention (Carapuço *et al.*, 2017; McGreavy and Hart, 2017) and disseminate the information in an appropriate way (Duncan, S., Manners and Miller, 2017; Elliott, Snoeijs-Leijonmalm and Barnard, 2017). To this end a portable demonstration model of the WireWall field rig has been designed and engineered. The aim was to develop an eye catching, accessible and user-friendly hands on tool showing the new advances in technology to measure overtopping velocity and volume using capacitance wires. Its impact at events has shown the tool's capability in attracting public interest to facilitate knowledge exchange, an important consideration within the design and conduct of research (MacMillan, 2011; Phillipson *et al.*, 2012). Following its success at outreach events it has been used during field deployments to initiate in situ engagement

opportunities between the public, coastal practitioners and researchers to develop support for a new scheme being planned at the WireWall study site in Crosby North West England. Here the 900 m sea wall will reach the end of its design life in the next 5 years. The WireWall project has converted existing wave measurement technology into an overtopping event observation system. Its deployment at Crosby will provide our partners with the key site-specific data and calibrated overtopping tools that they need to design a new, cost-effective sea wall.

The future health and wellbeing of coastal communities depends on clear communication of new research that is making sense of changing seas. The development of decision-support tools (Brown et al., 2018a) often uses online visualisations of numerical simulations. However, for this project an innovative portable demo has been developed to enable hands on interaction with the novel technology. The communication facilitated through the design approach used to develop this tool, has turned knowledge and technological innovations into accessible information for government, business and the public. We present a successful engagement strategy, outlining our activities and evaluation methodologies to achieve research impact. By working in partnership with local and government authorities our impact supports the public consultation activities by coastal managers, adding value to the research and also ensures our innovative measurement technologies are adopted in time within coastal monitoring strategies converting our outputs into research outcomes.

In Section 2 we provide the methodology applied to develop our public engagement strategy. Section 3 presents our impactful results and Section 4 evaluates the success of the approach. Finally we conclude in Section 5 with a set of key requirements for others to plan successful pathway to impact for their environmental research.

## **2. Methods to deliver inspiring engagement.**

To develop outreach tools that can be used for both business and public engagement they must be of high quality to showcase new innovative research and technological excellence, but also be designed with consideration of the user experience. Here a standard communication plan is considered:

- Identification of the issue/requirements
- Understanding of the desired outcomes
- Action to be taken to provide the solution
- Impact assessment

## **2.1. Hands on Science demo planning and design**

A great deal of consideration must be given to the design of an outreach tool with the initial emphasis being on the user experience and of identification of the desired outcome from the engagement activities. It is also important to make it look professional, ensuring its functionality represents the technology or research outputs being communicated.

For the WireWall project an outreach demonstration tool was required that would:

- enable the communication of coastal hazards to the public
- work as an education tool that could easily be taken into schools
- showcase the innovative technology and potential of the new measurement system to coastal managers and consultants

To deliver these requirements an outreach rig has been designed and manufactured to represent the research rig and the coastal system at our study site.

Our goal in developing the WireWall outreach rig was to ensure that its appearance was such that it would capture imagination, encourage curiosity and stimulate engagement from a wide ranging audience from all walks of life.

Lego was used to replicate the sea wall at the case study site, Crosby (Figure 1a). Not only is Lego an excellent model building tool but it has the added benefit of being familiar to most of the population irrespective of age, education, socioeconomic status or gender. Its popularity in public outreach has recently been highlighted by Andrew Street who noted that “the beauty of Lego in public outreach and education is its sheer familiarity. Nearly everyone messed around with it as a kids, and thus it is comfortingly familiar in the often confusing world of Physics” (Street, 2018).

Thinner and more sensitive versions of the capacitance wires were laced through a mock up structure (Figure 1b) and enclosed in a perspex high sided tray along with the representative sea wall (Figure 1c). The tray was designed to contain the water used within the demo so it could be used at indoor events with people walking around. A number of possibilities were put forward in order to demonstrate overtopping including throwing small cups of water and paddles to generate waves. However, after much deliberation, it was decided that water pistols were most likely to attract people’s attention and encourage engagement. By using pump operated pistol rather than trigger operated pistols the user also has the control to simulate water jets of different speeds to represent different severities of wave overtopping.

In addition, the fine water pistol jet enables the user to target a different number of wires within the system to explore the response to the technology, which encourages discussion. Two handheld wave generators (aka the water pistols) were used to prevent anyone being isolated while taking part in the demo, which can be off putting as not everyone is confident in taking part in STEM (Science, Technology, Engineering and Maths) activities. This also provokes competition or allows for encouragement within family and friendship groups. The water pistols chosen were identical, bright in colour with no perceived gender bias. With a mother of four leading our engagement strategy we knew that even children who are generally thought to be unaffected by societal stereotypes can sometimes prefer to wait in line to use the pink/blue option!

Whilst the above was thought to be enough to attract and retain attention, we decided to add Lego figures to the outreach rig, more specifically placing them on the Lego sea wall. Trials of the outreach rig, with willing staff volunteers, found that once they had observed the effect of the water coming into contact with the wires, and understood its significance, then the next step was to shoot at the figures – the temptation was too great! By seeing their reaction we felt that this would provide a perfect opportunity to enhance interaction even further at outreach events by humanising the effects of the overtopping. A Lego person being knocked over swept off the wall has a strong visual impact and allows the initiation of conversations to show that overtopping can cause immediate danger to human life, damage to property, roads etc (Geeraerts *et al.*, 2007). The Lego people were the start of our education plan as we realised the public would quickly engage in a discussion about wave hazard. By knocking or not knocking over the Lego with different speed water jets we could enter a discussion around storm severity, the consequences of climate change at the coast and the existence of shoreline management plans (SMPs). This naturally lead to a discussion about the measurement technology and how it can provide an evidence base to inform decisions to deliver local policy options within an SMP and the design options for new coastal schemes.

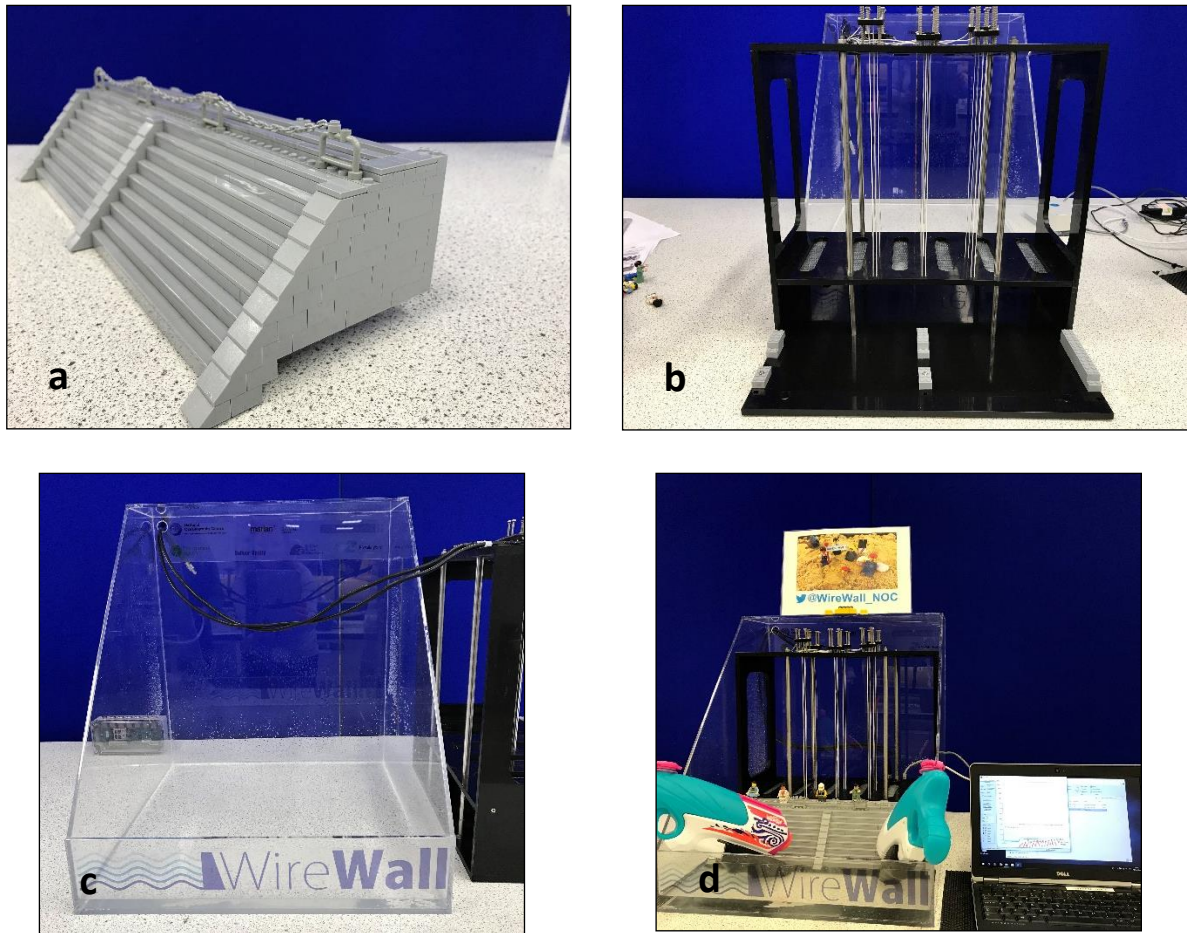


Figure 1: The WireWall Lego demo, the key components are: a) the sea wall representing Crosby beach, b) replication of the WireWall system, c) the high sided container and d) the complete rig with electronics.

The demo rig uses the electronics and GUI (Graphical User interface) developed for the real instrumentation. For the purpose of engagement the software allows real-time visualisation of the capacitance signal, calibrated to represent the length of wire that has been soaked, when the water pistol jets form a contact between the capacitance wire and the ground wire (Figure 1d). The graphical display can be put onto a large screen (Figure 2a) or simply a laptop, depending on the venue, facilitating discussion with a group while people take it in turns to be the ‘wave generators’. The display visualises a measurement for 6 wires in two rows of 3 along the sea wall. The different timings of the peaks in signal as water contact is made can be used to explain how we use these data to calculate the volume and velocity of waves overtopping a sea defence. The size of the exhibition space and access to power is a critical factor when choosing the type of display used. When at outdoor events the system also has the option to be run without the display and electronics (Figure 2b). Under this



scenario, batteries can be used or the Lego can simply be used to inspire on site discussion about hazards with print outs of the graphical information made available to explain what the representative WireWall system does.



Figure 2: Application of the demo rig at a) a NOC Open Day and b) at Crosby beach.

## **2.2. Standalone project communications**

Whilst the demo rig works well as a contribution to other events, such as open days and coastal processes awareness days, conference ice breakers or external exhibitions, it also works well for standalone project communications. The demo on its own provides an interactive point of interest that can be used in breaks at project workshops or also as a tool that can be taken into schools to communicate about STEM research. It also enables a more interactive alternative to poster presentation at scientific conferences. To ensure high uptake of the demo rig it was important to raise awareness of its availability. The rapid expansion of social media platforms presents a considerable opportunity for increasing public engagement (Wu *et al.*, 2018). Within this project we have advertised through social media channels run by both the NOC and with our project partners or coastal stakeholders who have formed a wider interest group for our research.

The key coastal groups that we have worked with are the Sefton Rangers and the NW Forum. The Sefton Rangers patrol the coastal amenity hotspots along the 16 km Sefton coastline seven days a week. They are available to speak to the public, report issues to the local authority and carry out daily checks. The rangers have a community focus using Twitter @GreenSefton\_ and Facebook<sup>1</sup> to send out regular news and updates about Sefton coast and countryside.

The NW Coastal Forum<sup>2</sup> is a communication channel for both the public and coastal practitioners that runs parallel to the NW coastal group. It is used as a mechanism for web communications and delivers targeted conferences to address certain coastal issues or topics of interest topics @NWCoastalForum.

The WireWall project has used the online communications channels from both these groups to advertise engagement events and raise awareness about the project. This enables us to instantly contact the local community who have an interest in the coast without us having to identify and build a community interest group. Alongside communications through existing social media channels we have a project twitter feed @Wirewall\_NOC. Initially we used the organisations feed @NOCnews, however, this limited the amount of content we could disseminate as this has to cover all of the National Oceanography Centre's (NOC's) wide ranging science and technology activities. It also restricted what we could retweet, as we have a clear focus on raising awareness of coastal hazards we wanted to be able to retweet hazard warnings and events/information linked to coastal resilience in addition to releasing our own material.

It is important to make the tweets fun and appealing (Figure 3 a to d) to rid people of the misconception of stuffy science. The use of Twitter also captures the developing story as the research progresses through its target milestones. While Twitter provides a current communication of activities, past information is also captured for new followers to engage with. This provides a complete real-time public friendly way to document the project keeping the local community, our international wider interest group and project partners informed. The funding body can also see project progress and impact.

← Tweet

 **WireWall project**  
@Wirewall\_NOC

Our [#WireWall](#) [#lego](#) people are [#beachready](#) and can't wait for to be part of [#LISCO](#) goes to the Beach at the Ainsdale Discovery Centre tomorrow. They will be there between 10-12. [@GreenSefton\\_](#) [@NOCnews](#) [@LivUni](#)



1:11 PM · Aug 16, 2018 · Twitter Web Client

View Tweet activity

1 Retweet 4 Likes

**a**

← Tweet

 **WireWall project**  
@Wirewall\_NOC

The [#WireWall](#) team are on their way to [#Ainsdale](#) Discovery Centre. Are you ready to join the scientists at the beach? Wave generators (water pistols) at the ready! [#LISCO](#) [@NOCnews](#) [@livunigeog](#) [@livuninews](#) [@GreenSefton\\_](#)



8:12 AM · Aug 17, 2018 · Twitter Web App

View Tweet activity

3 Retweets 8 Likes

**b**

← Tweet

 **WireWall project**  
@Wirewall\_NOC

[#WireWheels](#) is off to a rolling start. We got good and wet today, fingers crossed the [#WireWall](#) data loggers were recording! We'll find out back at the lab. [@NOCnews](#) [@Marlanmaritime](#) [@hrwallingford](#) [@seftoncouncil](#) [@balfourbeatty](#) [@EnvAgencyNW](#) [@GreenSefton\\_](#) [@CrosbyBeachFOG](#)




5:18 PM · Oct 26, 2018 · Twitter Web App

View Tweet activity


5 Likes

**c**

← Tweet

 **WireWall project**  
@Wirewall\_NOC

Wellies and waterproofs on for an early start down at the WireWall site in Crosby. AND LOOK WHAT WE GOT - our first data set! Woo hooo. Everything crossed for a bit more tomorrow. [@hrwallingford](#) [@NOCnews](#) [@channelcoast](#) [@seftoncouncil](#) [@Marlanmaritime](#) [@CrosbyBeachFOG](#) [@GreenSefton\\_](#)



5:25 PM · Oct 25, 2018 · Twitter Web App

View Tweet activity

3 Retweets 14 Likes

**d**

Figure 3. Examples of inspiring images and captions that appeal to the public to attract them to attend events and engage with the innovative new research. a) Lego getting beach ready. b) Advertising events on the day. c) Communications about project progress. d) Communication of initial results.

Reaching out to external audiences is something that Twitter is exceptionally good at as it allows live dialogue visible to all, unless private settings are activated (Liang *et al.*, 2014). The London School of Economics noted in their blog (LSE Blog, 2011) that making links with practitioners in business, government, and public policy is easy to achieve with Twitter's brevity, accessibility and immediacy being very appealing to non-academics.

### **2.3. Evaluation of the engagement**

It is vital that all communication plans continually go through a Plan>Do>Review cycle. Following review if the plan is not having the desired impact it will require revision to ensure it remains effective. Even if the approach is effective a review helps identify why this is the case. Every activity and/or event will be different so understanding what works and what does not work is key to successfully delivering a range of engagement activities. Even when repeating the same activity at a different location the engagement many need to be changed to suit the audience or the facilities. It cannot be assumed that an event can be repeated in a new location or at a new time in an identical manner.

At the end of each month, Twitter can be used as a simple metric to assess how your communications through tweets are working for you and your project. This metric is an effective tool to assess external project impact and wider engagement. There are a number of ways in which this works. Firstly you have the instant and obvious measure of engagement in the form of likes, retweets (Figure 4a) and increased follower numbers after events. In addition Twitter has its own powerful analytical tool which can generate a number of engagement statistics including, more interestingly, the number of impressions recorded by each tweet (Figure 4b). This refers to the total number of times a tweet has been seen including views on a followers' timeline, a result of someone liking it or as the result of a search (Chen, 2018). Furthermore proliferations in activity can be tracked so success of engagement activity can be easily quantified.

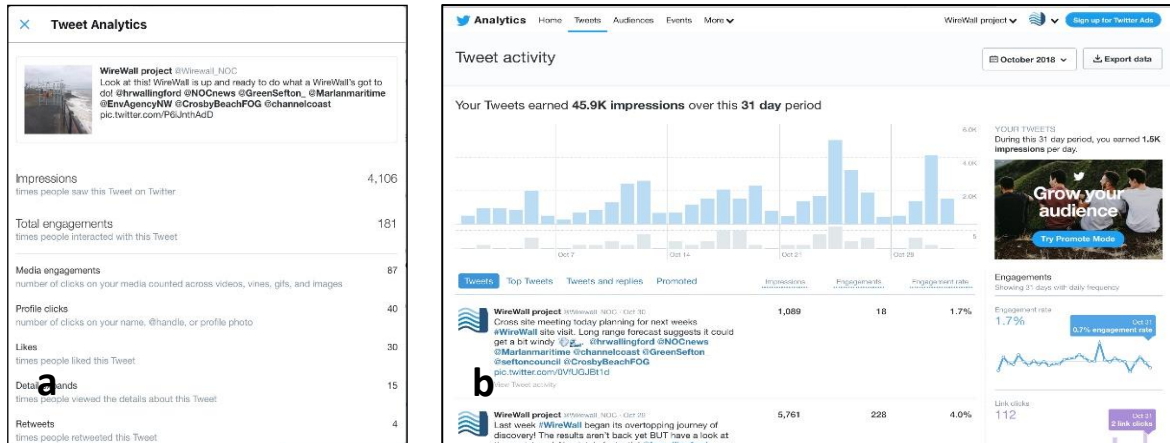


Figure 4 a) Individual tweet analysis and b) a summary detailing 28 day activity.

Knowledge exchange during events can also be effectively captured through word clouds, which themselves can be recomunicated through tweets and social media channels. Within our public engagement event people were asked for words they associated with the coast before participating in activities and afterwards. This approach captures the knowledge transfer as people met our scientists and interacted with hand on science demos. In the word clouds, the size of the word represents the number of times it has been suggested. To assess the knowledge transfer we analyse the content of the word clouds looking for differences. Our success criteria is that new words, scientific terms and an increase in size of keywords representing the research message that we wished to convey is seen in the final cloud when compared with the first.

### 3. Results with impact

The WireWall demo rig was initially designed for a NOC open day. Following its success it has been used in numerous outreach events, conferences and exhibitions (Table 1). This has enabled the WireWall project to engage with a range of people interested in coastal hazard management and risk assessment. The wide range of events attended have also raised project awareness within the academic community, with coastal practitioners, policy makers and the general public. The impactful results from initial activities during summer and autumn 2018 have also raised interest with the Government of Jersey in using the demo as part of an awareness raising programme alongside the development of their first SMP to build island wide preparedness for changing coastal hazards.

Date	Planned Events	Invited Events	Targeted Events
9th June 2018	<b>NOC Open Day</b>		
18 <sup>th</sup> June 2018		<b>UKRI visit to NOC</b>	
26 <sup>th</sup> June 2018	<b>WireWall project meeting</b>		
2-4 <sup>th</sup> July 2018		<i>Sea-Level Futures Conference</i>	
6 <sup>th</sup> July 2018		<i>Birkenhead High School</i>	
20-22 <sup>nd</sup> July 2018	<i>BlueDot Festival</i>		
31 <sup>st</sup> July 2018		<i>London International Youth Science Event</i>	
15 <sup>th</sup> Aug 2018		<i>Ainsdale discovery Centre as part of LISCO</i>	
29 <sup>th</sup> August 2018		<i>Crosby Beach as part of LISCO</i>	
12-13 <sup>th</sup> September 2018			<i>Marine &amp; Coastal Engineering Expo</i>
7 <sup>th</sup> November 2018			<i>UK Marine Climate Change Impact Partnership</i>
12 <sup>th</sup> November 2018		<b>CTBTO workshop</b>	
13 – 15 <sup>th</sup> November 2018		<b>Marine Autonomous Technology Workshop</b>	
25-27 <sup>th</sup> February 2019			<i>OI Americas</i>
14 <sup>th</sup> March 2019		<i>Mersey Maritime Awards</i>	
9-11 <sup>th</sup> April 2019			<i>Offshore Survey</i>
11 <sup>th</sup> April 2019		<i>Schools outreach (Into University charity)</i>	

Table 1: All events in which the WireWall Demo has been used since it was developed .Those in **BOLD** represent internal events and those in *ITALIC* external events.

Alongside the events the project twitter feed is proving to be a great success in engaging with a wider audience. Both tweets with public appeal (Figure 3) and research development (Figure 5a and b) are used to communicate key messages and breakthroughs within the project. Within 11 weeks the project had 114 followers. As the research team moved towards fieldwork the local community groups (@GreenSefton\_@CrosbyBeachFOG @Crosby Bubble) began retweeting our communications reaching a wider audience and raising awareness of both the project and shoreline management at the local case study site. During the first deployment we received our record number of likes to date demonstrating the wider support for the project. As the project progressed a steady increase in Twitter activity was recorded in terms of likes, retweets and engagements. The January 31<sup>st</sup> deployment tweet

(Figure 5c) recorded 6142 impressions and 379 engagements, plus a 10% increase in followers.



Figure 5: Research developments being tweeted a) Deployment of the WireWall Field rig was deployed b) Communication of results. c) Increase in Twitter activity.

In addition to being a useful tool for making contact with the local community around the study area site Twitter has allowed us to engage with a large number of institutions, coastal practitioners and communities around the United Kingdom including engineers, coastal scientists, coastal groups and even a high profile scientist/television presenter. Globally we have made contact with coastal groups in the Americas, Europe, Asia and Australia.

Our social media activities and collaborative communications with coastal groups resulted in a clear impact for the WireWall project when it received an Industry Award for Positive Impact in March 2019. While the Mersey Maritime Industry Award<sup>3</sup> judges decided the initial category short listing is was the coastal community votes that secured the research team the award.

### 3.1. Knowledge transfer

Following our open days it was recognised we needed an approach to evaluate if our hands on science was facilitating knowledge transfer. To capture the success of our communication we used word clouds as part of the Liverpool Institute for Sustainable Coasts and Oceans (LISCO) outreach activities to visualise people changing understanding as they took part in





Figure 6: The word clouds capturing people understanding before and after the LISCO beach events. a) Pre-engagement cloud for Ainsdale. b) Post-engagement cloud for Ainsdale. c) Pre-engagement cloud for Crosby. d) Post-engagement cloud for Crosby.



Figure 7: LISCO goes to the beach at a) Ainsdale 17<sup>th</sup> August 2018 and b) Crosby 28<sup>th</sup> August 2018.

Each event was planned slightly differently due to the facilities available on site. At Ainsdale we had power so were able to have an inflatable life sized version of Autosub Long Range known as “Boaty McBoatface” at the entrance to attract people and we could run a laptop with the WireWall display. We also had kinetic sand as the venue provided shelter from the weather. This allowed us to talk about the role of biology in sediment erosion, an important topic for the NOC led BLUEcoast project<sup>4</sup>. We also had sediment sieves provided by the University of Liverpool to talk about sediment transport. For this activity people could collect sand at different locations from the beach and dune system and bring it back to the event for sieving. This location was ideal to talk about the development of dune systems and combined wave and tidal action forming the ridge runnel feature on the beach. We also had an offshore windfarm display to talk about renewable energy, and the consequences of climate change on coastal infrastructure. This is an important topic for the University led ARCoES project<sup>5</sup>.

For the Crosby event we were outside, exposed to the wind and had no power. Here we used the WireWall system without the display and had print outs of the graphics. By planning the event to coincide with spring high tide there was the odd spray from waves coming over the sea wall due to the windy conditions. This enabled us to relate the Lego demo to real

issues and present day management activities, helping promote awareness of the SMP. Having a view of an offshore windfarm at this site and the port of Liverpool also facilitated more discussion around coastal industry with the windfarm demo. Instead of taking the sand demos, which would have blown away, we used tanks and syringes to demonstrate how coastal observations are collected using gliders.

During both events leaflets, but more importantly stickers (with research vessels and gliders) were provided. The stickers were a hit with all ages and enabled our communication to be spread as people wore them when leaving the event.

For WireWall the events were a great success. The water pistols worked well. They enabled people to replicate storm and gentle waves, either knocking the Lego people over or not. The demo rig provided a great way to communicate about wave hazard to all ages. This is seen in the word clouds with the appearance of “hazard management”, “overtopping”, “defence” and “protects” appearing in the post-engagement clouds. At both sites the word “measurements” also appears, demonstrating a wider appreciation for the innovative research and technology development by the organisations within the LISCO.

Alongside both events the @WireWall\_NOC twitter feed was used to publicize the events. In each case the initial communication had to take away any preconception that the events would be dull science exhibitions, with professors talking at people about complex research. This was achieved by tweeting photos of the scientists involved in fun activities, in relaxed setting as they prepared to go to the beach (Figures 8 a to c and Figure 3b). Content was also provided to the Sefton Rangers to include on their Facebook site.

← Tweet

**WireWall project**  
@Wirewall\_NOC

Boaty is in Liverpool ready for an outing to the Ainsdale Discovery Centre as part of our #LISCO goes to the Beach summer events. Come along and say hello. We'll be there between 10-12 this Friday. @NOCnews @LivUni



1:12 PM · Aug 15, 2018 · Twitter Web App

View Tweet activity

13 Retweets 21 Likes

**a**

← Tweet

**WireWall project**  
@Wirewall\_NOC

Join us at Crosby beach on our next #LISCO goes to the beach event on 29th August between 12-2pm. Our Lego friends have been practising their poses! Watch out iron men you have competition @GreenSefton\_ @CrosbyBeachFOG @livunigeog @CoastalLego @NOCnews @livuninews



6:23 PM · Aug 24, 2018 · Twitter Web App

View Tweet activity

8 Retweets 9 Likes

**b**

← Tweet

**WireWall project**  
@Wirewall\_NOC

And they're off!! The #LISCO team have left the building. If you are lucky enough to live near Crosby Beach then head down to Hall Road. They'll be there from 12-2ish. @NOCnews @CrosbyBeachFOG @GreenSefton\_ @livunigeog @livuninews WE HAVE WATER PISTOLS!!!



**c**

X Tweet Analytics

**WireWall project** @Wirewall\_NOC

Boaty is in Liverpool ready for an outing to the Ainsdale Discovery Centre as part of our #LISCO goes to the Beach summer events. Come along and say hello. We'll be there between 10-12 this Friday. @NOCnews @LivUni pic.twitter.com/t9K0korkHy

Impressions	13,121
times people saw this Tweet on Twitter	
Total engagements	216
times people interacted with this Tweet	
Media engagements	137
number of clicks on your media counted across videos, vines, gifs, and images	
Profile clicks	24
number of clicks on your name, @handle, or profile photo	
Likes	21
times people liked this Tweet	
Retweets	13
times people retweeted this Tweet	
Link clicks	9
clicks on a URL or Card in this Tweet	

Figure 8: Advertising the events a) Inflatable ASV Boaty McBoatface getting beach ready b) Recreation of Antony Gormley's 'Another Place' art installation at the WireWall study site. c) LISCO members heading off to the beach d) Twitter analytics.

For the outreach events, with tweets from the WireWall project and retweets by Sefton Rangers, over 130 people interacted directly with the tweets by either liking or retweeting. However, by looking at Twitter analytics (Figure 8d), we can see that impressions, on average, recorded between 1400 – 2800 interactions per tweet. Within 13 weeks of being setup (November 2018) the project has 134 followers from a diverse range of backgrounds. These included local interest groups around the study area (@FriendsofCrosbyBeach), students, academics, flood forecasting agencies (@TheFloodHub) engineers, consultants and even a well-known television presenter/scientist (@helenczerski) While this raised awareness of the project in the local community where the research is taking place, the twitter feed also has a much wider reach. While not everyone who engaged with the tweets showed up on the day. Twitter still enabled us to engage a wide audience with communications about our research. One particular tweet recorded over 13,000 impressions by November 2018 (Figure 8d).

Following the success of the demo at our NOC open day it was used to facilitate discussion in business exhibitions around the UK (see Table 1). Attendance generated opportunities to exhibit, and invitations to present, at both national and international events and help to grow our networks as discussed in section 3.3. Our presence at Oceanology International and use of twitter hashtags to promote our stand and presentations had high impact, reaching out to science reporters. Following this event the project team and members of the project's wider interest group were interviewed for an article in Nature (Witze, 2019).

### **3.2. Knowledge exchange**

The aim of this project was to deliver knowledge transfer through awareness raising. The objectives were: (1) to engage with the public so coastal communities and users are better prepared for changing coastal hazards; and (2) to promote our innovative technology and measurement capability to coastal practitioners (the end user communities) to create a pathway to impact for our research. We found that during the discussions facilitated by the demo knowledge exchange also occurred.

Exchange is either a two-way learning process or information sharing process. By facilitating events for scientists to speak with the public helps to improve their communication skills. For example, the choice of language needs to be appropriate. A 6-year old uses terminology such as speed rather than velocity when talking about fast and hazardous water jets that come over a sea wall during storms, while adults may be more familiar with the term overtopping waves.

Ensuring the scientists also benefit from the activity is therefore important so they participate in future events. For universities outreach is associated with attracting new intake for a course, but in research centres it is about developing a national reputation for being a leading centre of excellence. The importance of public engagement throughout the scientific community was highlighted by The Chair of the Research Council UK Executive Group, Prof. Alan Thorpe (Research Council UK, 2018) *"Public engagement can provide substantial benefits to the researchers involved in engaging the public, as well as providing a major contribution to society. Engaging the public can also improve the quality of research and its impact, by widening research horizons. We achieve this through involving, listening and interacting with the public (from science communication in science centres or festivals, to consultation and public dialogue)"*.

Outreach also had other project benefits. Using WireWall as our example, meeting with people at the beach enabled us to collect more information about the conditions that pose a hazard. This helped us verify what the numerical tools were telling us in order to prepare for field deployments. Other project benefits included interaction with the Royal National Lifeboat Institute (RNLI). Forming contacts enabled us to work in partnership. Arrangements were made to use their station to mount a GoPro to record impact on our field rig during deployment and we were provided with access to power for the use of power tools in the initial preparation stages of the fieldwork, removing the need to transport and hire a generator. In return the fieldwork attracted a lot of attention so we could communicate about hazards at the beach. Our tweets now include @RNLIlifeguardnw and we also retweet the coastal flood warnings for this site communicating hazard to the local community. The event at Crosby also allowed us to interact with the local fisherman. Building a working relation was critical as we would be working on the prom at spring high water, which is prime time for bass fishing. Through effective engagement prior to fieldwork we have been able to introduce our research aims and in effect 'make friends' with the local beach users so they are receptive to sharing the prom during the winter storm period (Figure 9a). Many of them have taken a keen interest in what we are doing and understand the concepts behind the project. This has enabled us to leave equipment on the prom overnight during fieldwork with

a reduced risk of vandalism or tampering. During deployment, signage giving links to our Twitter account, was also left on the rig in order to inform local residents and visitors about our research. The inclusion of signs on the field rig also facilitated public engagement during deployments (Figure 9b).



Figure 9: Deployment of the WireWall rig 25/10/2018. a) WireWall deployed beside the local fisherman. b) Members of the public engaging with signage communicating about our research and directing them to the twitter feed during deployment.

The 'LISCO goes to the beach' is another example of knowledge transfer. By working with the Sefton Rangers to advertise 'LISCO goes to the beach' we met with another local interest group 'Friends of Crosby Beach' (FOCB). We now include @ CrosbyBeachFOG in tweets about our research. This has allowed us to make contact with other local community groups (@IronMenCrosby @Crosbyvillage, @CrosbyBubble, @Bootle\_A\_G who now follow and retweet our research (Figure 10a). Many of these groups also have Facebook pages and have included communications about WireWall deployments as the team have deployed the rig (Figure 10b). Through FOCB we have gained vital knowledge of local communities and have been able to engage further with other interested parties. The Sefton Rangers also included WireWall within an article for an October edition of a local free newspaper (The Midweek Visitor) to increase the media coverage of our research<sup>6</sup>.

We have also provided content to the NW Coastal Forum for their website and newsletter<sup>7</sup>. This outlet enables us to engage with coastal practitioners and raise awareness of potential new measurement systems available to us in the Regional Coastal Monitoring Strategy. In consequence the NOC was invited to host the November Liverpool Bay Coastal Sub Group meeting with a field trip to see WireWall. The conversations and discussion during the event are the first step in ensuring uptake of the research outputs following the project. It is through these activities that impactful research outcomes are achieved that deliver National Public Good.

Increasing public interest and understanding of the importance of the research helped safeguard the rig during deployment on the prom and while in storage in the Coastguard compound. This was vital as the equipment was stored and deployed in publically accessible places so was at risk of tampering, vandalism and theft or theft of parts. By obtaining community buy-in continued communication occurs as people interact with friends and family while enjoying the coast as a natural amenity. Flyers about the project were also left with the burger van and ice cream van who frequently visit the Crosby carpark. This is a key source of communication at the local scale.

Communications by others to raise awareness of the WireWall project before deployment built a strong local collaboration. Communications about the project not only benefits our research, but also the local authority who are our project partners. This research has initiated awareness about the planning and design of a new coastal scheme at this site, which Sefton Council can now build on with their own communication plan. It has also raised awareness about coastal hazard helping to strengthen the communications from the Sefton Rangers, RNLI and Coastguard, who all have a presence at Crosby. Outcomes like this help build good relations to secure project partners for future research. It also helps us deliver research. Examples of good collaboration include the use of the Coastguard station compound to store WireWall between deployments and use of the RLNI station to mount equipment during deployments.

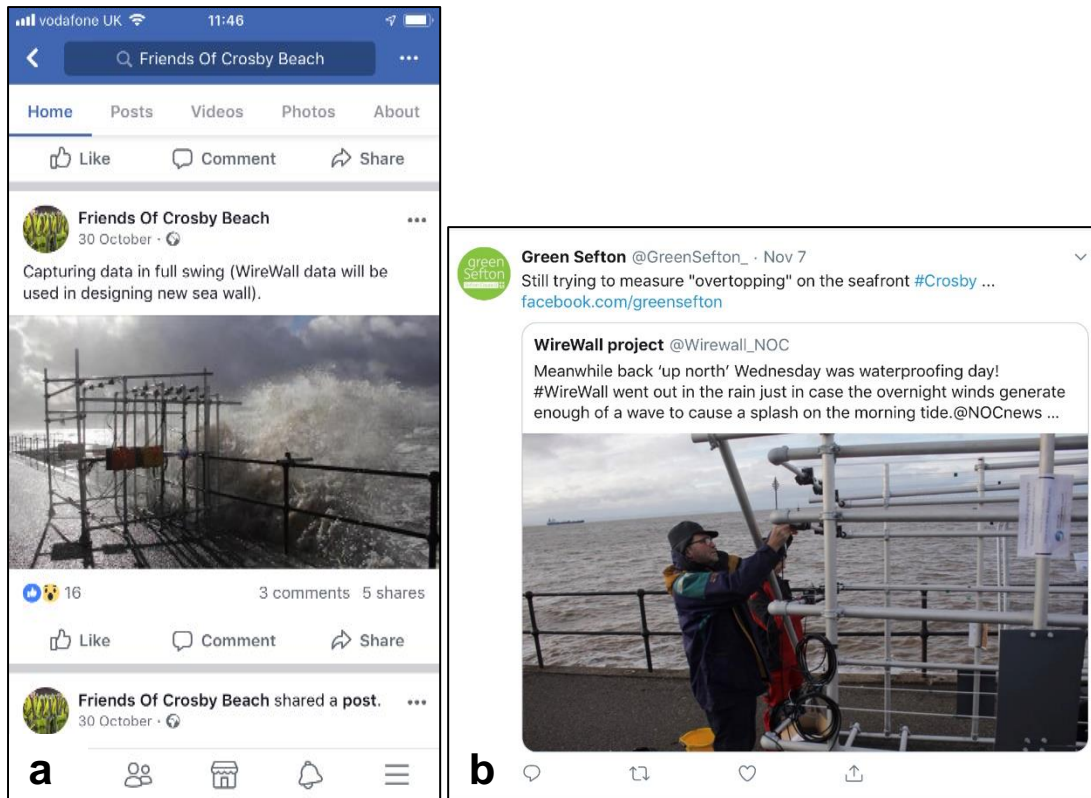


Figure 10: Recommunication of the research through twitter and Facebook by a) FOCB and b) the Sefton Rangers.

Our outreach events also allow us to understand what communication styles work. To ensure innovation continues to grow in the UK it is important to promote STEM activities with schools. At our events we had researchers from different stages of their careers, which is also important to inspire the next generation of scientists. One of the critical features of the WireWall demo is its portability (Figure 11). Use of the rig in schools has led to an interest from the Government of Jersey in the possibility of NOC providing an education service.





Figure 11: The NOC Liverpool Site Head taking part in a careers event with WireWall during STEM week at Birkenhead Girls School (July 2018).

Conversations with the public during outreach events have also helped inform researchers of the public perception of coastal management. Researchers at the NOC, who are part of the WireWall project, also have an advisory role to different coastal groups within England, Wales and Jersey. By understanding public perceptions of coastal hazards through outreach events helps inform engagement strategies when delivering new coastal management activities, including new schemes or a change in shoreline policy as coastal management adapts in time (Jefferson *et al.*, 2015; Luís *et al.*, 2018). As coastal flood and erosion hazard changes in consequence to climate change and rising sea level, coastal adaptation strategies will include both early warning and education schemes as local communities become better prepared to respond to, and live with, changing coastal hazard.

The outreach rig proved to have another, and rather unexpected, benefit. One of our events was attended by a gentleman who after many successful years as an engineer became blind and had to retire. He received the NOC newsletter regularly and had been particularly interested in WireWall. By having the outreach rig available at the event it allowed him to bring the science in our newsletters to life in a medium that was not based on sight. A model of an autonomous underwater vehicle (AUV) also known as Boaty McBoatface was also on display at the same event. The writing on the side of the AUV was raised and allowed the gentleman to feel the name on Boaty bringing new meaning to “Hands on Science!”

### **3.3. New opportunity and network building**

As mentioned earlier, during the LISCO event we met with the community group, “Friends of Crosby Beach” (@CrosbyBeachFOG) who invited us to take part in their annual Marine Awareness day. This demonstrates the impact of ‘Hands on Science’ in developing new opportunities to increase awareness of and promote coastal research and key research messages. Their annual event is also a great way to raise awareness of the NOC in the local community. Their communications have also led to questions from the public about the coastal defence, initiating communications about the planning of a new coastal scheme at this site providing an engagement strategy for the local authority to build on when building the new scheme within the next 5 years.

Opportunities to attend other business events also resulted following the NOC open day (June 2018). Our open day, hosted at our larger Southampton site, enabled greater awareness of the innovative research taking place at the Liverpool site with all staff. Following the successful interaction with the public and the NOC directorate we have had numerous invitations to attend events (Table 1). Marine and Coastal Civil Engineering (M&CCE) in September 2018 highlighted the importance of displaying partner logos. Environment Agency staff who were interacting with the demo rig noted the connection and were keen to have the outreach rig at their Flood and Coast 2019 event. This is an event which brings together government, local bodies, specialist in technology and local communities with a view to discuss new ways of working and to deliver excellence in FCERM – an excellent opportunity for further engagement. In addition, an invitation was received to attend InterFLOOD Asia in 2019 at a discounted rate. As we have numerous projects working in overseas developing countries where flood and erosion risk is an issue, this was also a good opportunity. During Marine Autonomy and Technology Showcase (MATS) November 2018 a number of interesting conversations took place with both national and international based companies and institutions including FUGRO in the UK and The Quebec Government Office in London with whom the need and subsequent use of WireWall technology in Canada was discussed. The same event also sparked interest nearer to home with the Mayor of Southampton thoroughly enjoying a turn with the water pistols.

At all events, without exception, the novel approach to engagement by using water pistols instead of posters brought a lot more interest to the NOC stand than was anticipated.



Figure 12: The demo rig in action at a) the NOC open day being used by our director, b) Flood Expo 2018 providing a networking opportunity for engineers within the project and c) at MATS - meeting the Mayor.

Twitter has also enabled our research to be disseminated through larger existing networks increasing our followers. The use of Lego prompted engagement with @CoastalLego who are a Coastal Group in the South East of England. The result of following their “Coast Buster” activities and directly messaging them to find out more led to them engaging with a

WireWall webinar<sup>8</sup> and tweeting about our research (Figure 13). Following this seminar, which advertised our twitter feed, our followers increased by approximately 15% as we reached new audiences.

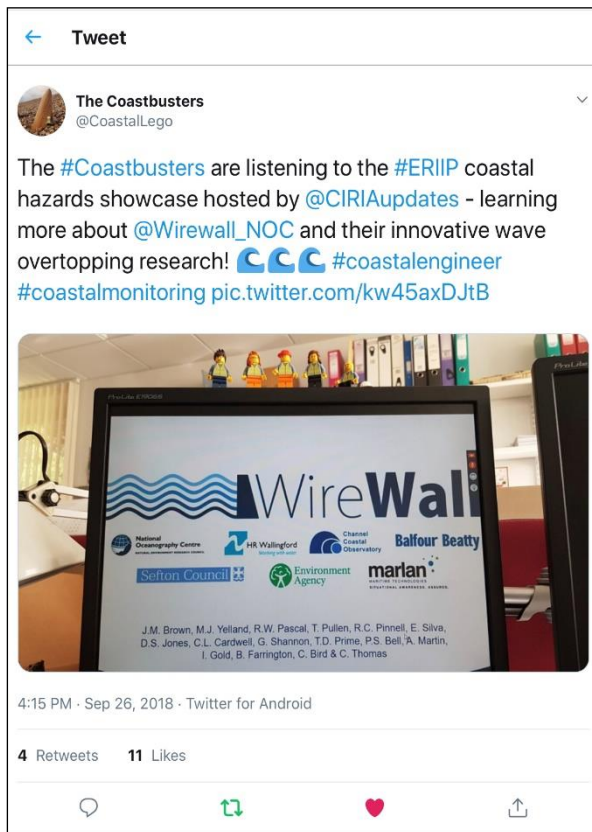


Figure 13: A tweet about a WireWall webinar due to the Lego connection with @CoastalLego.

As our followers grow (164 by the end of January 2019, 253 by the end of April 2019) we promote and raise greater awareness of our research within coastal groups, local authorities and other researcher organisations. This generates the potential for new project partners in follow-on proposals for the WireWall technology and initiates opportunity for a consultancy service to deliver our ambition of initiating a step change in coastal hazard monitoring.

Outreach events using the demo rig as part of 'LISCO goes to the beach' generated new opportunity. The outreach team were invited to be part of a University of Liverpool led proposal that successfully secured an Impact Acceleration grant to communicate about coastal hazard. There have also been discussion with writers at the university to develop an illustrated walk that can be led from the NOC stand during the 2020 FOCB Marine Awareness Day<sup>9</sup>. The team were successful in obtaining an AGU 100 grant to take forward

this initiative<sup>10</sup>. Capability to successfully deliver public engagement opportunities thus has potential to diversify income opportunities that enhance the pathway to impact for research outputs.

The demo rig is also a great way to turn a poster presentation at a conference into an interactive conversation. The demo was used at the Marine and Coastal Climate Change Impacts Partnership Event in November 2018 to accompany a poster presentation, thus allowing people to see the technology and how it works, alongside the research aims. This provided great benefit for the research project as lots of contacts were made and business cards were given out, which will hopefully lead to opportunities (funding through collaborative proposals or enhanced uptake of research outcomes) and new partnerships in the future.

#### **4. Discussion**

The development of a Lego demo to accompany the WireWall research project has had great impact at public and business engagement events. One thing that we have realised is a set of business cards with key project outputs and contacts are required so people have the information to hand if they wish to make contact in the future. The contact details could be for the project lead or include a general email for an organisation products and services team if they have one. In our case this is the Marine Data Products team, who sit within our Strategic Business Development group who are responsible for business and collaboration developments. While many follow twitter this does not provide information to all, making business cards a useful tool to enable continued communications.

While the use of twitter is quite standard, the way in which events are delivered can vary greatly depending on the audience, location and facilities. Our most successful tweets have been those with an appealing image, this might be the Lego having a day out, researchers out at the beach hands on building kit or a photo of a nice scene such as a large storm wave. Twitter has its own metrics to enable analysis of what's engaging and what's not (see section 2.3). These can be regularly reviewed to understand what our followers are interested in to tailor ongoing communications. For public events those in attendance must stay alert and adapt the approach during the event to ensure it works. It is also important to capture this information for future planning. The use of Twitter also had an unexpected, but very welcome, benefit as we were able to ask for support in the form of votes when the project was shortlisted for an award<sup>3</sup>. Below is our summary of what did and did not work for public engagement. However, at other venues this could be very different.

#### **4.1. What worked well?**

The use of Lego has proven to be a great way to link the research with public engagement activities. We found through Twitter that many others are also using Lego in communications associated with coastal hazards. We were able to form good relations with this community and access existing networks to quickly build our own followers. The vast public appeal of Lego also meant people were happy to be in photos with us when out on site deploying the WireWall rig.

Many people of all ages form a connection with Lego, making it a great way to initiate a discussion to exchange knowledge. It's also very portable so can be carried by the research team to any event to enable a continuous feed of related tweets. In our case all tweets were coastal hazards, coastal resilience, shoreline management planning and coastal flood and erosion risk management related. This wider communication helps promote a wider range of ongoing research activities at the NOC and within LISCO alongside the project's focused communications. It also provides opportunities for others to take advantage of the communications, for example the Sefton Council are able to use this to start raising awareness about new coastal scheme at our study site and gain buy-in ahead of their engagement strategy starting.

The professional finish of the demo rig and incorporation of the cutting edge technology being used in our innovative research makes it suitable for business events also. The versatility of the rig, i.e. being used with a big screen, small laptop or simple print outs of the graphical information means it can be used in a range of facilities such as the beach, small or large exhibition venues and school classrooms. The fact that the demo can be contained in a small space, requiring a single small table also enables it to fit easily into exhibition spaces, or be incorporated within poster displays at conferences. The high sided tank design enables the electronics and laptop or screen to be positioned side by side. This also helps keep everything together so the user can be 'hands on' and see the results and technology at the same time.

Our beach events were planned for school holidays when we hoped there would be a larger number of people visiting the seaside. The event at Crosby, our study site, was planned to coincide with high water during spring tides. This meant people were coming up off the beach as it was inundated and remained on the prom for a few hours while the beach was drowned. This site is home to the Antony Gormley art installation, which draws people to the beach. However, many do not realise they can only see the statues as the tide falls or is out.

Being positioned on the prom provided something for people to look at while they waited for the tide to fall.

Spring tide is also prime fishing time so members of the research team could meet with the local fisherman prior to deployment as the WireWall rig could be competing for the same location on the prom. Discussions provided the team with descriptions of storm conditions and also a working relationship for use of the prom. We were able to show the position we were going to be in and the size of the rig. At every deployment we have regularly met with a number of fisherman who now come to say hello and see if we've collected any data. One thing that was critical was to clarify that the experiments would not change the beach or the coastal system. It has been one of the best years for bass and quite good for cod so there was concern we would disrupt the current yield.

Using a visitor centre and beach carpark where dogs were allowed was beneficial as many of the visitors were dog walkers. This enabled more people to speak to us, as some would not have called in if they had to leave their dog in the car. Each event also facilitated its own discussion. Ainsdale Discovery centre is situated in the sand dunes. This location promoted discussion around sediment transport, beach morphology and coastal erosion. We could introduce new ideas such as the role of biology within the sediment transport process education people about EPS (the sticky goo excreted by creatures, or as the word clouds say "Worm Pee") and the effect of burrowing worms on sediment mixing and bed stability. Crosby carpark was ideal for talking about wave hazard and relating water pistols to overtopping waves. At high water the gentle breeze caused waves to spray onto the prom nicely illustrating what we were trying to communicate through our demo. The windfarm in the background also provided a talking point around the renewable energy windfarm demo. Liverpool port also allowed us to talk about coastal industry and working with nature.

At both events we had a series of ocean research stickers, which included "Boaty" and a research ship. These had great appeal with children and unexpectedly with a few of our more mature visitors! This also helped spread awareness of the events to a wider area over the beach. Having a scout out and about with stickers speaking to people to promote our presence also helped identify who came to speak with us because they were inquisitive, and who had been caught by the scout (identified by their sticker).

The use of word clouds was ideal for capturing the knowledge transfer and providing a way to assess the success of the event. Was the desired message communicated? Was there a change in understanding? The events had very mixed attendees, but if we had an event

were there was a clear demographic category (e.g., age) this approach would also capture information about peoples understanding from different demographics. Our word clouds only capture the different conversations due to the location of the venue and the demos taken. The Ainsdale set include sediment transport and coastal management, while the Crosby set focus more on wave hazard, measurements and coastal energy. Repeating the word cloud approach to capture information at an open day away from the beach would also be a way to assess how different events facilitate different engagement. This approach could be used for a single demo in isolation to determine the effectiveness of project related communications. The publicising of the word clouds on twitter, social media or within newsletters along with photos also helps inspire people to come to future events as they can see what the level of participation is. In addition, they provide a record or evidence base after the event to demonstrate the effectiveness of an approach when looking for new opportunities or justifying the resource requirements.

#### **4.2. Lessons learnt!**

Following our events some key considerations were identified for incorporation into future outreach activities. For demos that require power, a battery option should be built into the design of the system to ensure the full demo can go anywhere. There also needs to be consideration for the length of any cables used. While there is the potential to cause a trip hazard if using a power supply the equipment must be able to connect. Also laptops or screens must be able to be used on either side of a demo, if the connections are on one side cable length must again be considered. In the case of WireWall the electronics are all on the left and we like to have the box on show so people can see the technology being used. Short cables and a power supply on the right poses the problem that the box may need to go behind the demo, so the power supply can be connected and the electronics protected from getting too wet. Normally the layout is to have the electronics at a safe distance to the left of the rig. When designing future demos we will factor in the requirement that a demo must be able to run with any table and power supply configuration. Our current rig is slightly biased to a set up going from left to right of power, laptop/screen, electronics and demo. Although we can power the electronics by the laptop which does give us some flexibility. Having a number of pre-charge laptops then also allows us to be self-sufficient.

If returning to Crosby, we may consider going to the carpark in the middle of the prom where free parking is available. This was suggested by FOCB who use this venue, as pay and display parking can put people off if they are only considering to travel for the event. Being on site midday also meant there were more people at the beach in the Crosby carpark as



this is a popular lunch spot for tradesmen as they can park with a view. If an event is only running for a couple of hours timing is critical to coincide with beach users. Visitors are unlikely to rush to the beach early as they might be enjoying a leisurely start to a day out. Those at the beach early are likely to be busy dog walking or exercising before work and not want to stop.

Even though we were in accessible locations, one of which had free parking, we still needed to draw a crowd. People do not naturally walk up to a stand of scientists unless they see others getting involved. People need to see what they might be asked to do before they commit to joining in. While we had an inflatable version of an AUV Boaty McBoatface at Ainsdale so people could see something was going on, many beach users did not know we were there as we were hidden in the dunes. At Crosby, we realised we should have taken our “photo face board” to have something (that did not require power) that stood away from the stand to catch people’s attention. Signage to say what we were doing and why we were there would have been beneficial. On realising this we sent out a scout with stickers and flyers to promote our existence and give directions. This worked well, but did not result in a rapid response. People wished to have a walk, lunch or a coffee first then come call in at the stand before going home. Time must be factored in to allow people to complete their planned activities before they engage with an exhibition. Sending a scout out before the event is open to the public would have been valuable. The scout themselves has to be quite confident as many people sit in their cars, enjoying a bite to eat or drink, to stay out of the weather and watch the view.

The success of the demo rig can also be its downfall when used to add content to another events. For example the demo was used as part of Bluedot Festival 2018<sup>11</sup> at Jodrell Bank. The aim was to increase the number of demos for the people to engage with. However, its success meant it drew attention away from the main content of the stand and as a result it was pulled for the remaining days as it was seen as a distraction from the theme. In this case our demo was more popular than “Boaty”. If part of another event, position is critical to draw people in. Those running the stand must then have good communication skills to entice people into the main sections of an exhibition. At the LISCO events people seemed equally interested in all activities on offer as staff moved them round the demos. There is the potential that if indoors some audiences may cause chaos with the water pistols so the staff resource must allow someone to stay with this demo if some level of control is needed.

During small outreach events that are hosted outside, location and weather will be critical in drawing large numbers to the exhibits. Whilst the weather cannot be controlled,

consideration to provide a bit of shelter needs to be factored in. Having demos under a gazebo in the shelter of the RNLI station seemed to work well at Crosby, although we were only sheltering from the wind. If the exhibition is set back from public walkways or parking you should consider yourself as being in a hidden away location and are likely to require a beach scout to raise awareness of the event. This should be factored in when planning staff resource. If the day is cool and cloudy, then lower visitor numbers to the beach may also require a scout to draw in the initial crowds to attract attention. Having something eye catching outside or in a main walking route so people know an event is happening is advisable. In the case of the Ainsdale event that was inside, the provision of activities for kids and shelter from the wind was appealing once people knew we were there. We found that larger numbers came after they had their lunch on the beach and wanted to warm up!

Event timing is critical. Midday to early afternoon seemed to be when people called in before going home. If too early (before 11am) there is not an audience but after 11am visitors to the beach on days out/holiday started to appear. Sending a scout out early for an hour before the event opens would be advisable as it took at least an hour for anyone they spoke to call in on the demos. Our events ran from 10am-12pm (Ainsdale) and from 12-2pm (Crosby). We found nearly everyone came to the Ainsdale event in the last hour. The enthusiastic staff running the event enabled us to stay beyond the advertise time to engage with the late rush, we did not pack up until 2pm. If we had been time restricted without the flexibility to stay longer our engagement would have been limited. The later start at Crosby worked well. We had a continual drift of people through the event, but again we did have nursery group call past just as we were planning to pack away, so delayed our departure to speak with them. Ensuring staff resource is flexible to potentially stay longer than planned at beach events is crucial to capture a good number of people if you are not planning on being there all day.

During our activities we met with local beach users, tourists and were pleasantly surprised that a school party happened to be on the beach at the same time. Planning a visit to have coincided with school activities that use Ainsdale Discovery Centre may have worked better as weather cannot guarantee there will be a crowd of beach goers. This is something that we will consider in the future.

As much of our demonstration equipment include plastic parts due to their nature some of the public focused on this in Facebook comments rather than on what our event was about. At future events we will take a notice to acknowledge the use of plastic, pointing out we reuse our demos and due to their water based nature, or their requirement to contain fine

sand, plastic is required. In our lab we take the protection of the environment seriously by maintaining ISO14001 Environmental standard, limiting the use of plastic and sourcing alternative material where possible. However, for this kind of offsite engagement activity the kit must be light, robust, safe and allow people to see into tanks where used. This is the key consideration for the equipment's design.

## **5. Conclusion**

Impactful (award winning) research requires a good communication strategy with eye catching and interactive materials to supplement the plan. Becoming a smart user of social media can help you translate your research into impact (Harvard Business Review 2016). This project has done just that using twitter to communicate the adventures of the Lego WireWall research team who take part in all research activities from fieldwork to conference attendance and have their own demonstration. A set of key messages from our WireWall engagement strategy have been identified.

A science demonstration must meet the following requirements to be successful:

- 1) Be eye catching with appeal for all ages to attract attention.
- 2) Be hands on to get the end-user involved, provoking thought and inspiring questions for the scientist.
- 3) Be professionally made to a high standard to showcase excellent science and/or technology.

If running a small public event at the beach there are also some extra requirements to make an event a success:

- 1) Having a scout to walk the beach and carparks is recommended.
- 2) Clear signage to say why you are there is required.
- 3) Having something large that people can interact with away from the stand to attract attention is also advised.

In the case of the WireWall demo it has two roles. The first is to raise awareness of coastal hazard during extreme storms; and the second is to communicate about innovative technology in development at the NOC. This makes it very versatile for a range of events from public outreach to business development and thus is seen as a cost-effective resource within the 'Strategic Business Development' and 'Government, International and Public Engagement' teams within the NOC. While it forms a pathway to impact for the WireWall project, it also delivers the NOC remit to 'encourage public engagement and dialogue',

'communicate research outcomes' and 'generate public awareness'. A clear measure of its success are the growing opportunities and increasing interest in the WireWall project that have been generated since the demo rig was created in June 2018. As the project continues we aim to use our skills in effective engagement to enhance our science through new partnerships, generate greater impact and more rapid uptake of research outcomes, visibly align to stakeholder requirements, strengthen networks, enhance our reputation and finally, generate growth and revenue for the NOC. It is hoped that the recent release of WireWall - The Movie<sup>12</sup> will help to further support and enhance our positive engagement journey. In one month of its release it was one of the highest viewed NOC research clips within the last year due to our high international profile and public interest raised through our engagement activities.

Whilst we remain committed to research and will always be funded predominantly through competitively won research income, we also aim to diversify our funding streams through commercial opportunity, consultancy and licenced IP. To achieve this a strong engagement strategy, that accompanies and compliments our research, is required.

<sup>1</sup> <http://facebook/greensefton>

<sup>2</sup> <http://www.nwcoastalforum.org.uk>

<sup>3</sup> <http://www.mersey-maritime.co.uk/mm-events/mmia19/>

<sup>4</sup> <https://projects.noc.ac.uk/bluecoast/>

<sup>5</sup> <https://www.liverpool.ac.uk/geography-and-planning/research/adaptation-and-resilience-of-coastal-energy-supply/>

<sup>6</sup> <http://globalnewspapers.today/uk/midweek-visitor>

<sup>7</sup> <http://www.nwcoastalforum.org.uk/2018/11/17/wirewall-update/>

<sup>8</sup> [https://www.ciria.org/Events/Post\\_event\\_information2/2018/ERIIP\\_showcase - Coastal Hazard.aspx](https://www.ciria.org/Events/Post_event_information2/2018/ERIIP_showcase_-_Coastal_Hazard.aspx)

<sup>9</sup> <http://sarahhymas.net/colne-rising/>

<sup>10</sup> <https://centennial.aqu.org/celebrate-100-grant-winners/>

<sup>11</sup> <https://www.discoverthebluedot.com/>

<sup>12</sup> <https://youtu.be/a5Y33SWdNU4>

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