Royal College of Art
Postgraduate Art and Design

SAFETY GRAND CHALLENGE:

SAFE SHIP BOARDING & THAMES SAFEST RIVER 2030

Lloyd's Register Foundation

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Safety Grand Challenge: Safe Ship Boarding & Thames Safest River 2030

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Royal College of Art & Lloyd's Register Foundation

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“Design for Safety at Sea” Symposium (© LRF)

The standard ship ladder has hardly changed in 300 years (© Ashley Hall)

Executive Summary

This report describes the first Lloyd's Register Foundation Safety Grand Challenge and details how a collaborative, cross disciplinary design research and teaching approach can provide a platform for a broad variety of participants to develop projects in a complex design safety environment, encourage collaboration and industrial involvement in design education and contribute to a balance between technological developments and the needs of people in the future.

The Royal College of Art, generously supported by the Lloyd's Register Foundation and working with a group of industry stakeholders, investigated two major areas of risk within the maritime context: Sea Safe transfers from ship to ship, and making the Thames the safest city river by the year 2030. In a four month project, thirty-two postgraduate participants from eleven disciplines and six researcher-tutors at the Royal College of Art worked together to tackle these complex and wicked design challenges using a number of novel design methods.

With a focus on finding cutting-edge innovative design solutions that would reduce risk on the ship to ship transfer and on increasing safety on the River Thames, the research project explored a wide range of approaches that encouraged collaboration, innovation and risk taking in design research practice. The different cultures, practices and knowledge bases led to an array of eight pioneering design solutions, ranging from product-focused innovations through to systemic solutions, material innovations and educational strategies.

This report makes a case for the culture of design engaging with risk on water in the context of the wicked problems (Rittel & Webber, 1973; Buchanan, 1992) we identified, the methods and techniques used to tackle these challenges, how cross disciplinary projects can lead to novel insights, and how design education can be used to engage with industry and users to bridge the gap between technological innovation and user needs.

Our conclusions support the view that this approach can develop implementable new design for safety solutions, incorporate social, cultural and psychological human factors into safety design and balance users' needs by engagement through an appropriate use of technology. Furthermore, we uncover insights into training designers for safety critical environments and the implications this has in terms of projects, cross disciplinarity and practices in the role of design thinking in general.

Introduction
The Partners

Lloyd's Register Foundation

The Lloyd's Register Foundation is a UK charity established in 2012, which mission is to protect the safety of life and property and to advance transport and engineering education and research. To meet these aims the Foundation awards grants and engages in direct activities; the work of its trading group also contributes to the achievement of its mission. The Foundation has prioritised four research themes: structural integrity and system performances; resilient engineering; human and social factors; and emergent technologies. (Lloyd's Register Foundation, 2016). The Foundation is not funded by the public; any funding is generated from the profits of its trading arm, Lloyd's Register Group Ltd, and investments. This organisation employs around 9,000 people across 78 countries and operates in the sectors of compliance, risk and technical consulting with expertise in the interface between assets, systems, people and processes. In the 2013/14 financial year charitable spending was £17.2 million (Lloyd's Register Foundation, 2014) rising to £34.6 million of new awards in 2015/16 charitable funding was £12.7 million, equivalent to 65% of their income (Lloyd's Register Foundation, 2016).

The Lloyd's Register Foundation directs their funding towards four key areas related to these themes - structural integrity and systems performance; resilience engineering; human and social factors; and emergent technologies. This aims to accelerate the uptake and application of research and breakthrough technologies to enhance safety, to translate ideas and research into industrial applications and to enhance the use of research evidence in developing regulations and standards. The industries that this research supports varies from transport (aerospace, automotive, marine, rail and metro) to energy (oil and gas downstream/upstream, power and utilities) and also encompasses a range of other concerns such as food, built environment, healthcare and medical, manufacturing and IT and communications.

These projects tend to fit within the context of engineering and science, supporting the aim of the Lloyd's Register Foundation's target to be 'known worldwide as a leading supporter of engineering-related research, training and education' and to support this aim 'promote[s] scientific excellence' through grant making to 'connect science, safety and society'. Past and current research, including global foresight reviews, supported by the Lloyd's Register Foundation fits into this framework. Their partner institutions have focused primarily on engineering and scientific disciplines. Past partnerships have investigated topics such as robotics and autonomous systems and additive manufacturing, while some of the current research projects include data-centric engineering, energy storage and nanotechnology.

In July 2016 the Lloyd's Register Foundation awarded a grant to the Royal College of Art (RCA) to work together on a Safety Grand Challenge, focusing on two key areas framed by a maritime context.

The first of these focuses on a specific method and object, while the second is a more strategic topic, with a larger scope and context. The aim of this Grand Challenge is to bring together a broad range of expertise to tackle complex and wicked problems that have endured in safety and risk scenarios

The first topic of research is that of Safe Ship Boarding using pilot ladders, a topic motivated by the number of marine pilots involved in non-fatal and fatal accidents while boarding a huge range of ships in varying weather conditions to guide them into their home port. This has a narrow focus, but a global impact on the equipment and methods used in this process. The second topic is a response to the Thames Strategic Review (Wright, Moller, King, Michalaki & Lush, 2016) and focuses on making the river Thames the safest in the world by the year 2030 in the context of the development of housing, transport, communities and activities on and around the river. This has a wider scope, calling for a more systemic and strategic approach and could lead to city wide impact developing knowledge for other cities across the world.

RCA School of Design

In awarding a grant to the RCA, the Lloyd's Register Foundation started working with an academic institution situated in a different disciplinary field to previous partner organisations. Founded in 1837, the RCA is the world's largest solely postgraduate art and design university with over 1,800 postgraduate designers across 24 specialised programmes, led by a roster of 96 full time academic staff and 800 visiting professors and lecturers. The RCA is a research intensive postgraduate institution that sets the global agenda for current and future directions in art and design research and practice. This is achieved through a unique teaching approach across academic and disciplinary boundaries, developing creative innovation and leadership in postgraduate designers and helping to shape future industry leaders.

The School of Design is the specific faculty group within the RCA that applied for funding from the Lloyd's Register Foundation and consists of five MA programmes (Design Products, Global Innovation Design, Innovation Design Engineering, Service Design and Vehicle Design) and four research degrees including MRes Design, MRes Healthcare Design, MPhil and PhD. The MA courses run for two years and train postgraduate designers in skills ranging from practical application to theoretical concepts, engendering a culture of experimentation and innovation through the application of design methods and thinking. There are also a number of activities within the SoD that connects staff and postgraduate designers working together on research projects internally, with industry partners, academic institutions, third sector organisations and stakeholders with other interests and disciplinary backgrounds.

Previous research projects with external stakeholders have included projects with Airbus, BBC, Ford Europe, Intel, Huawei, Microsoft, Philips, Samsung, Tata, the Victoria and Albert Museum, the Science Museum and governmental funding bodies including the AHRC, EPSRC, Innovate UK (Technology Strategy Board), Future Cities Catapult and Transport Systems Catapult.

The Innovation Design Engineering (IDE) programme sits within the SoD and is the specific course at the RCA that is working in partnership with the Lloyd's Register Foundation. The course offers joint MA/MSc degrees, teaching to MPhil and PhD level and has an extensive research cohort and network.

RCA Team

The background work in preparing the grand challenge project was developed by Ashley Hall, Professor of Design Innovation at the RCA, where he directs the Design Innovation research group of MPhil/PhD candidates and leads the MRes Healthcare and Design and MRes Design pathway. His research interests include design thinking, the cultural transfer, experimental design and industrial design pedagogy. The further research and development of the topics was lead by Dr Laura Ferrarello, Coordinating Tutor and Mike Kann, Research Associate. Dr Ferrarello is a visiting lecturer to the IDE programme, where she leads the Experimental Design strand. With a background in design, architecture and research, her interests focus on complex system dynamics, social relationships, physical design and digital infrastructure through engagement, participation and interaction. Mike Kann is currently a PhD candidate at the RCA, working as part of the IDE Research cohort. His background is in the design of technology driven objects, installations and research, investigating the implementation of the Internet of Things (IoT) and the use and appropriateness of technology in innovation when considering material culture and cultural practice.

The researcher-tutor group involved in the project also included Robert Pulley, Matt White and Chang Hee Lee, who all have complementary areas of expertise enabling us to tackle many of the issues that are relevant to the development and delivery of design led innovations tackling risk and safety on water. Robert Pulley is a current PhD candidate at the RCA within IDE research group with a strong track record in teaching and broad experience of education and design research focusing on pedagogy. Matt White is an experienced IDE tutor who leads the second year Disruptive Market Innovation strand and runs a successful design consultancy with expertise in developing products for marine environments. Chang Hee Lee is a current PhD candidate in IDE research and an expert in design engineering, electronics and the technical aspects of product construction. His research focuses on synaesthesia and the role this can play in creating new products and interfaces.

Aims and Objectives

In working together, the Lloyd's Register Foundation and the RCA aim to create and develop a range of innovative potential solutions to increase safety on the water through a new working relationship that will be mutually beneficial in practical, methodological and organisational terms. As well as supporting direct future collaborations between the two organisations, the knowledge transfer and skill sharing developed through the project also allows both organisations to work with other partner in new sectors and disciplines.

The Lloyd's Register Foundation and the RCA have similar shared interests in innovation for safety through developing tangible, implementable projects. Technological elements and engineering are an important factor for both organisations in terms of product development, innovation driver and suitability for market as they underpin new technical solutions that we can bring to reducing risk. Both organisations have a shared concern for the human and social factors around risk, with design thinking connecting both the technical and social aspects of safety. The human led focus can influence the organisational understanding of problems and their effects, from large scale societal impacts to a more granular understanding of the place of individuals and pieces of equipment within large systems. Finally, both organisations are focused on creating positive change and innovation that affects the real world through the use of emergent technologies and research based evidence to drive concepts and solutions.

The Lloyd's Register Foundation has a substantial depth and breadth of knowledge relating to the technical elements of engineering issues that underpin the project and a rich extended network of information, organisations and individuals that span across disciplines and industry areas, such as the Royal National Lifeboat Institute (RNLI) and the United Kingdom Marine Pilot Association (UKMPA). Engaging with these connections provided the specific and contextual knowledge that the RCA needed to develop and deliver innovation. The Grand Challenge also helped the postgraduate student participants to develop their skills, disciplinary understanding and explore new areas of interest and expertise. This helped the development of the support team of six RCA researcher-tutors in organising, delivering and reporting on projects. More importantly, this support extended to evaluating outputs and concepts as part of a panel of experts and disseminating this information through promotional materials, reports and an exhibition. Through this process the postgraduate designers at the RCA were able to deliver a range of outputs that addressed the topics of the brief through innovation and targeted a specific problem area, which lead to real world development and implementation.

The key area of expertise from the RCA that directly benefited the Lloyd's Register Foundation is the positioning and use of design as a way of engaging with safety on water. This methodology is driven by design thinking, problem solving through synthesis, interdisciplinary thinking and an iterative, practice-based research model, where theory and research informs outputs (Cross, 1982). This position and the methods implemented within this type of research can be used

as a way to understand the various interests of stakeholders, the complex and sometimes unusual systems in which these solutions are placed. The methods focussed on the role and positioning of people using technologies within the complex systems of safety on water and the role of innovation in improving scenarios with a focus on addressing the culture, human factors and technical appropriateness of solutions.

Our core aims were:

- To develop a new culture of safety driven by the application of design methodologies
- Develop implementable and transferable solutions that prove new concepts for reducing risk
- Develop new thinking and insights from design thinking focused on safety
- Integrate design for safety into the education of a diverse group of postgraduate postgraduate designers
- Build new partner relationships between maritime and rescue agencies with the Lloyd's Register Foundation and the RCA
- Engage project partners and stakeholders throughout all stages of the project
- Disseminate our projects and findings through public exhibitions, seminars, publications and academic papers.

Ships crew rigging a pilot ladder (© Ashley Hall)

Research Focus
Design for Safety

The Grand Challenge initially started with a long list of safety issues considered by the Lloyd's Register Foundation and the RCA. These included reducing the 80 people a year who drown at sea (RNLI data). Besides risk our challenge included the integration of high technology into safety procedures: robots and autonomous systems, drones, and the Internet of Things. We also looked at improving proprioception for slips, trips and injuries; helicopter pilot disorientation; near miss reporting; cargo hold asphyxiation; ship personnel transfers and Thames River safety. We selected the contrasting projects of ship-to-ship transfers as a deep, narrow focus and the Thames Safest River 2030 as a broad, future project to illustrate the way that design thinking can tackle immediate, longstanding and strategic future safety issues.

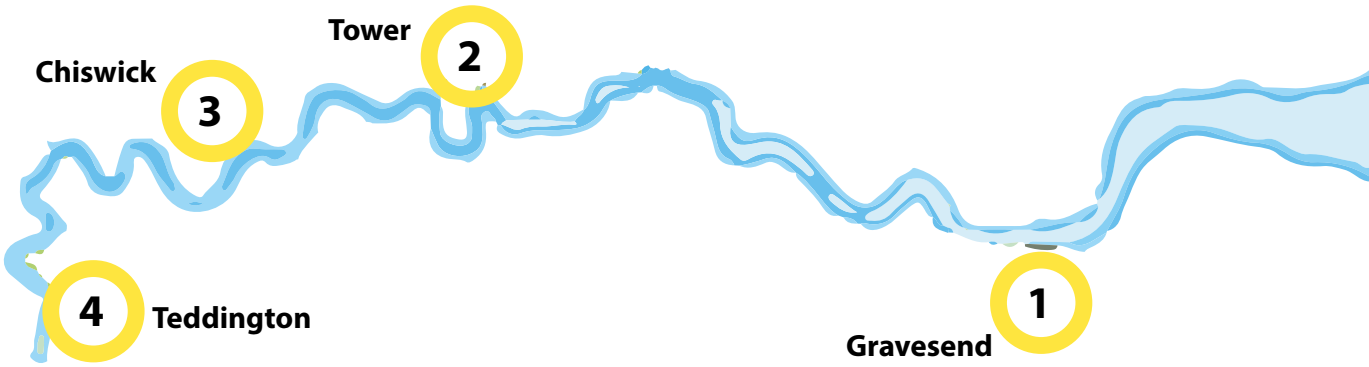
Our first impressions of the two topics led to some preliminary insights that helped to inform the development of the research through meetings with stakeholders and initial field trips. These impressions were based on a relatively uninformed understanding of the topics which at this point formed an overview of the two main research topic areas, rather than an understanding of their intricacies and details. However, these initial perceptions were valuable in creating a shared starting point to work from, helping to shape the development of the research questions by signposting areas of interest or directions that the project could take.

Safe Ship Boarding

The area of Safe Ship Boarding focused on the role and importance of marine pilots, the methods and equipment they use to get on on or off a ship and the wide range of situations that this can be carried out in. To develop an understanding of this, some early research helped to define the core elements that would inform future direction and developments.

Marine pilots are experienced in commanding a large variety of vessels and have an expert knowledge of their home port, allowing them to manoeuvre and berth ships faster and more safely than the ship's captain, who may have a more generalised knowledge of the area. Marine pilots generally board the ship that they will drive outside of the port limits, guiding them to a berth or through the port and then disembarking once the ship is safely berthed. This process is very important to the maritime industry, as it is an efficient and safe method of navigating waters that are unfamiliar to the ship's captain, allowing for a faster turnaround of commercial vessels and keeping ships and goods moving safely.

The focus of the design research challenge is the method used by the pilot to embark and disembark the ship that they will pilot into port and the surrounding safety issues relating to this process. This boarding is conducted by the crew lowering a wooden and hessian rope ladder with highly prescribed design (International Maritime Organization, 2011) and rigging (International Chamber of Shipping, 2008) regulations for a pilot cutter that is manoeuvred alongside the commercial vessel. The pilot then climbs up or down this ladder to board or disembark the commercial ship, even in extremely unpredictable conditions: heavy rain and snow, high winds, a +50 to -40 Celsius temperature range, large swells on the sea and total darkness. The equipment used is based on



Map of the RNLI stations on the river Thames

traditional construction methods, materials and climbing from the era of sailing ships and have changed little in 300 years (Hignett, 2012). This method has a number of dangerous elements and despite strict regulations (SOLAS, 2012), there are still a number of accidents and some fatalities involving marine pilots when boarding or leaving a ship. Accurate accident rates are hard to source though one southern UK port described a 1 in 100,000 accident rate. The global rates are also difficult to define but the CHIRP website (CHIRP, 2017) gathers incidents and the IMPA conducts regular surveys (IMPA, 2006). The surveys break down the incident and failure type and are useful to focus design effort on the most common cause of failures. Although none of these sources have definitive global numbers and the aim of this research was not to gather data on incidents, it became clear that significant number of risks to life incidents were taking place.

Pilots readily acknowledge that one of the main challenges designers will face is the low investment and 'grandfathering' attitudes of the industry which can cause a resistant attitude towards investment, change and innovation. One ship's pilot pointed out that the majority of ship's crew came from countries that were at the higher end of the Hofstede index (Hofstede, 2011) for power distance. This generalised cultural attribute indicates the perception of distance between oneself and a superior manager. In this instance the indication is that the power distance is the most extreme between individuals and relates to a much lower likelihood that a superior officer's decision will be challenged, even when it is learly wrong, hence reducing safety and increasing the likelihood of accidents.

Thames Safest River 2030

This challenge involves the many issues involved in making the Thames the safest river in the world by the year 2030, when future housing developments along the Thames will aim to deliver the Mayor's 'City in the East' target of building 200,000 new homes in the vicinity of the river (Mayor of London, 2016), which will add a population equivalent to that of Birmingham to London between Greenwich and Gravesend (Mayor of London, 2014). This increase in the number of people living in close proximity to the river will lead to an upsurge in river usage for transport and leisure activities. To understand the implications of this, we conducted initial research to outline the key aspects that would impact upon future direction and development of the project.

The river Thames is the longest river in England, the source of which is the Thames Head in Gloucestershire and which runs through London and out to sea via the Thames Estuary in Kent, as shown above. This tidal river has a large number of people, clubs and communities that use it for a range of activities, from commercial activity such as shipping, public transport and pleasure cruising; recreational uses such as rowers, swimmers and residential communities of canal boat owners. There is also a range of people interacting with the Thames from the riverbanks and bridges surrounding it, from residents of post-industrial riverside developments, Londoners walking along the Thames, tourists visiting the city and people drinking at riverside pubs and bars. This range of communities and reasons for using the

Thames contributes to a diverse and wide ranging set of concerns and interests in which the river and a variety of ways in risky situations can threaten people's lives.

The aim of making the Thames the safest river in the world is a complex, multifaceted topic. Unlike Safe Ship Boarding, which has a clearly definable area to be explored, this topic comprises of a number of elements that need to be considered as a whole. This early definition of the problem area primarily focused on the role of the RNLI on the Thames in dealing with rescuing members of the public due to accidental falls, drunken trips or suicide attempts and how to prevent this type of event through education and prevention. Other influences on river safety were also taken into account, such as increased demands on river based transport (Mayor of London, 2013) and the impact that this might have, changes in water quality due to higher sewerage and wastewater (CIRIA, 2007), the role of the built environment in preventing people accessing the river Thames (HSE, 2016) and the impact of climate change on water levels (WWF, 2008).

Initial Understanding & Brief Evolution

Our initial understanding of the topics led us to realise that while the two areas differed in specific focus and application, generally they represented different aspects of the issues of working and living on the water and all the attendant challenges and dangers this can bring in managing risk in high stress situations. Both are also suited to a cross disciplinary, collaborative approach, using a design research and practice-led methodology to balance the needs of users, stakeholders and structures in improving safety.

There were a number of well defined, specific issues that helped to distinguish these two topics. Safe Ship Boarding involves a tightly knit, traditionalist community of pilots working on the water, using a specific procedure and prescribed piece of equipment in highly variable conditions. In contrast to this, Thames Safest River 2030 involved a large number of disparate communities working and living with the Thames, a host of general issues to respond to, the interaction of a stable built environment with an unpredictable tidal river and stakeholders excited about innovation and open to outside influences on implementation. In short, Safe Ship Boarding involved a narrower focus, concentrating on the deep complex design issues involved while Thames Safest River 2030 suited a broader, more strategic focus on future requirements.

There are also commonalities in these areas regarding the role of large organisations and their structures, the involvement of an array of global, national and local interested parties with differing aims, organisational inertia and commercial pressures. Both problem areas involved elements of engaging with communities and leveraging their shared knowledge, understanding the cultures embedded within their practices, issues surrounding trust and collaboration and the role of cross disciplinary working and innovation.

The early impressions and preliminary framing of the two areas indicated that there was a clear space for a collaborative, cross disciplinary approach using design methods and design thinking to attempt to unravel these complex problems and develop some alternative solutions that could resolve safety

in high risk complex situations. However, the two areas of focus needed some research and refinement before involving the design group in the work. To achieve this a number of field trips and stakeholder meetings were arranged with interested parties who could provide insights, inform our understandings and direct us towards a greater appreciation of the details involved in both topics.

Deployed pilot's ladder (© Ashley Hall)

Building the network Stakeholders

Field Trips & Meetings

Over six weeks from the start of August to mid September there were a number of meetings and field trips between the RCA team and the partner organisations in the project. These meetings strengthened the early working relationship between the RCA, Lloyd's Register Foundation and RNLI teams and providing networking opportunities with further external stakeholder organisations and interested parties. These provided the opportunity to develop a shared understanding of the overall project, supported the refinement of the scope of each topic and allowed for the development of a deeper understanding of the elements involved in reducing risk and saving lives on the water.

RNLI Video Conference

On the 5th August 2016, professor Ashley Hall discussed with Dr Will Roberts, Innovation Manager at the RNLI, the RNLI's role in making the Thames the safest river by 2030. The RNLI also practice ship to ship transfers during rescues, although these tend to involve far smaller vessels than commercial ships and don't involve the use of pilot ladders. Dr Roberts provided a number of useful insights into transfers, such as looking at offshore transfer methods used by comparable industries, including personnel transfer to oil rigs and windfarms or the variability of the weather conditions when transferring. His definition of the challenge was "How can the RNLI and partners make this stretch of water the safest in the world?" and informed us that the PLA were keen to be involved in the project, creating the opportunity to work with another partner organisation and involve their expertise.

Lloyd's Register Innovation Centre, Southampton

On the 11th August a meeting at the Lloyd's Register Innovation Centre in Southampton University was convened by Dr Vanessa Forbes from the Lloyd's Register and Prof Hall, which was attended by the members of the RCA Grand Challenge team, stakeholders from the Lloyd's Register Foundation and interested parties from the Royal Navy Command, Marine Accident Investigation Board, United Kingdom Marine Pilots Association and Associated British Ports. This meeting served as a forum for initial discussion between a range of interested parties and it was hoped that this would help to provide some insights into how each organisation involved worked and viewed the problem area, developing a shared foundation from which to work and to raise a new set of questions to inform further discussion and development of the project.

One early comment questioned the involvement of the RCA in the Grand Challenge, advising caution as there had previously been many new ideas that hadn't succeeded and that if there was an easy answer it would have been developed and implemented already. These concerns were alleviated after Prof. Hall presented some information on the history of the college, international organisations that the Innovation Design Engineering (IDE) department had worked with and case studies of prior research and graduate work. This showcased the collaborative, innovative working methods typical to the RCA and IDE and demonstrated that this project could lead to genuine innovation to impact upon accidents, injuries and fatalities connected with pilot

Field trip to RNLI Innovation Centre (© Chang Hee Lee)

transfers and ship boarding.

A number of key aspects relating to the project and relationships between the RCA and partner organisations arose during the discussions and presentations. Some of these were resolved at this meeting, while others provided valuable directions for the future of the project and insights into the different interests represented by the range of stakeholders present. These included the role of the RCA in the project, looking for inspiration from other industries, alternative methods of transfer, cultural differences in transfer methods between countries and ports, the concept and legal meaning of grandfathering, the details of material and construction of the pilot ladder, the statistics for pilot ladder related accidents and deaths and the standards and regulations surrounding this method of transfer.

RNLI Innovation Centre, Poole

Following the earlier Skype meeting a face to face meeting was arranged for the 31st August 2016, attended by Laura Ferrarello and Mike Kann of the RCA team and three of the RNLI's innovation department. A key part of this meeting was trying to understand the structure, processes and culture of the RNLI to gain insights into how an organisation that focuses on reducing risk on the water functions. The RNLI's remit at a strategic level is to look at all current risks and opportunities around the river for all activities and how to develop plans to deal with rescues, prevention and future issues through innovative thinking and methods. Based upon the conclusions of the Thames Strategic Review, the RNLI was interested in focusing on the projected population increase on the stretch of water between Tower Bridge and Gravesend. With no other lifeboat stations between these two and no plans for additional stations, the use of innovative methods is vital in developing alternative methods of rescuing people and prevention through engaging with the public to promote water safety.

A number of important issues were raised in discussions, such as the application of the Internet of Things; the role of education and outreach programmes; Health and Safety Standards and procedures; building regulations; tacit knowledge of weather, waterways and environments and engagement with the river through place-making. This led to questions about permissions for activities on the Thames, ownership of RNLI stations, piers and transport links on the river and plans for new station developments, what the RNLI understands by innovation, how they apply it and how effective it can be in a traditionalist discipline such as the maritime industry.

As the public facing message from the RNLI is to 'Respect the Water,' it is clear that they still want people to enjoy water based activities and engage with the water, rather than fear it. This is a position shared by the RNLI's partners, including the PLA who want to avoid the idea that the river is dangerous and are looking to shift the public perception. There is a general interest among the partners to develop common sense in people about water awareness, and perhaps the built environment of the future Thames developments could engender this through place-making strategies and by making the river a public space to share, live with and enjoy.

UKMPA Conference (© Mike Kann)

UKMPA Conference, Cowes

The 128th annual UKMPA conference in 2016 was held on 15th September at Shepards Wharf, Cowes on the Isle of Wight and was attended by a number of pilots from across the country and Mike Kann from the RCA team. The conference was an opportunity to develop links with pilots, gain an insight into their practices and attitudes in a relatively informal setting and to learn about the overall concerns of the organisation and its members through the conference programme. This focused on the concept of the "Golden Hour," the time span within which people who have fallen into water must be rescued for the maximum chance of survival. This spanned physiological responses to cold water, organisational issues surrounding search and rescue and the role of immediate casualty care by pilot cutter crew members.

During the course of the day some informal discussions took place between the RCA attendee and a range of pilots regarding pilot ladders, transfers, innovation in the maritime industry and the role of the RCA. The pilots had some interesting opinions regarding the frequency of incidents, the introduction or alternative techniques or additional equipment, the ladder itself and other comparable industries, such as aviation. On the whole the pilots did not seem interested in using alternative methods, materials or extra equipment and were positive about the qualities of the traditional materials used in ladders. There was also some discussion around the training and culture of pilotage – to become a pilot people spend eight years training for a master mariner and then another six to become a pilot. A final interesting point was the suggested difficulty in finding a universal solution that would make the process safer, as the maritime industry has many manufacturers, a huge variety of ships to suit different uses and harbours and a diverse range of standards across the world.

The conference programme started with an introduction from Captain John Pearn, Chairman of the UKMPA, who discussed the day's events and the context for the programme. Although many pilots say that transfers have gone smoothly, near misses and dangerous events happen and can be glossed over. The aim of the day was to provide pilots the information to ask the right questions and make the right decisions, without being prescriptive. The first speaker was Prof Mike Tipton of Portsmouth University, an expert in the physiological effects of cold water on the body. His presentation detailed the extreme situation of falling into cold water, with some stark comparisons of the number of fatalities due to drowning exceeding the combined number of fatalities due to fire and cycling accidents combined. He went on to discuss the physiological responses to cold water including loss of grip strength and Cold Water Shock (Tipton & Wooler, 2016), which can cause hyperventilation and gasping for breath, leading to people drowning through water inhalation.

The next session was led by Matt Leat, the Maritime Operations Controller for Her Majesty's Coastguard (HMCG), a subsection of the UK Maritime and Coastguard Authority (UKMCA) responsible for the initiation and coordination of all maritime search and rescue operations in the UK. His presentation focused on the role of HMCG in rescuing pilots if they

VTS control system, Port of London Authority (© Chang Hee Lee)

slipped and fell from the pilot ladder or cutter during a pilot transfer and the role that crew can play in rescuing people. The final speaker was Dr Paul Savage OBE, a volunteer and former Clinical Operations Manager at the RNLI and a key figure in the development of the RNLI's Casualty Care Card system (RNLI, 2016), which guides volunteers through an emergency situation and has proved to be effective in saving lives. His presentation discussed current First Aid training for pilots, which he felt was not fit for purpose. Instead, he wanted to focus on the provision of high quality CPR training, defibrillators and oxygen on pilot cutters, along with pilot-specific medical kit and a casualty care card system to help pilots administer aid in a high stress situation.

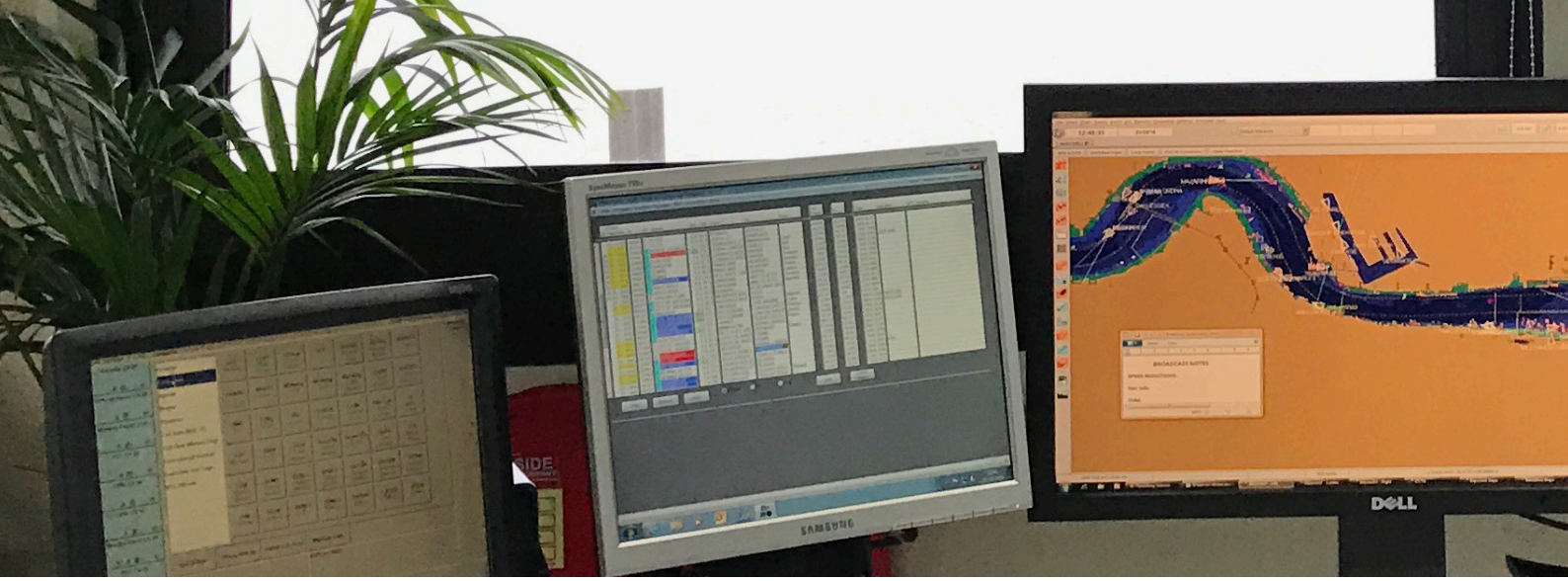
This conference helped to define some of the risks and topics relating to Safe Ship Boarding, as well as progressing our understanding of the context of the problem area and research questions. The more informal setting meant that the pilots were open about any concerns they had about the involvement of the RCA, the redevelopment of the ladder and any proposed innovations that might alter the materials, methods or systems surrounding the process of pilot transfer. There were some useful insights into the levels of medical and emergency training for pilots, particularly search and rescue organisations and procedures. This all contributed to a better understanding of the pressures and concerns of the pilots and the relationships between pilots, harbourmasters and the overarching organisational structures of the global maritime industry.

Port of London Authority, Gravesend

Through the introduction of the RNLI a meeting with the PLA was arranged for 21st September 2016, at which two members of the RCA team met with two of the PLA, Catherine Spain (Harbour Master) and Simon Phillips (Deputy Harbour Master) at their headquarters in Gravesend. The meeting concentrated on matters relating to pilot transfers, detailed information around ladder regulations and standards and the role of innovation in the maritime industry. We also started to plan a field trip for the postgraduate designers and discussed the schedule, activities and topics that it would be useful to introduce them to. Along with this, there was also a short tour of the facilities, including the piers and vessels used and the VTS control room, where the movement of ships and schedules of pilots in the port of London are organised.

The meeting began with a brief explanation of the project aims and context and why the RCA was involved, as this had been a sticking point in previous interactions with members of the maritime community. We clarified the two topics in the project and how the work would be developed by up to thirty postgraduate designers using design methods and thinking in an initial five day project. The goal of our visit was to brief the partners about the postgraduate designers engagement with the project, help prepare the topics and explain how postgraduate designers would approach the area, understand the overall problems and specific issues involved and establish a relationship with the PLA, leading to a field trip during the first week of the project.

The use of pilot ladders, the guidelines and regulations surrounding them and the risks of the pilot transfer method were issues that the PLA have a great deal of expertise in, as this is



VTS control system, Port of London Authority (© Ashley Hall)

something that happens a number of times a day in the water around Gravesend and beyond. With this in mind, the early part of the meeting focused on developing a broader and deeper knowledge of this topic, particularly focusing on the physical aspects of the ladder, including weight, rigging, materials, storage and how less skilled crewmen and commercial pressure meant that the ladders were more likely to be replaced than repaired.

We also discussed international standards for the storage, condition and rigging of the ladder, how they can be circumvented through flags of convenience and the ramifications of disregarding these regulations. Finally, we discussed the regulations and processes of a pilot transfer, including the role of the commander, officers and crewmen, the critical elements in a transfer, the impact of environmental conditions and the practices involved in moving from the pilot clipper to the ladder.

Following this, we visited the Port Control Room, where all the vessels travelling through the Port of London and the environmental conditions that affect the river are monitored via the Vessel Traffic System (VTS). We were shown how vessels are positioned and represented on the Automatic Identification System (AIS) and radar systems and discussed the role of the pilots within the port's activities. This helped to clarify where innovation and new technologies have already helped to change the maritime industry, the procedures and organisation involved in guiding vessels to berths or into port and the importance of pilot transfers to the UK economy and resources. We ended the day by discussing activities that could be arranged for the postgraduate designers, such as a presentation, a visit to the VTS and a visit to the RNLI station on Gravesend Royal Pier and a potential second visit from the RCA staff.

Thames Gateway, Gravesend

A second visit to the PLA at Gravesend on the 21st October was attended by Ashley Hall, Laura Ferrarello and Mike Kann and arranged for the purpose of observing a series of pilot transfers from a cutter. The RCA team viewed and recorded five pilot transfers and had informal discussions with pilots and crew. Following the afternoon of witnessing first hand the process of pilot transfers, we conducted an interview with Deputy Harbourmaster Simon Philips. During our visit to the VTS centre the operators described the large difference between ship and aircraft control and that the big issue with the Thames is that the large tide means that some of the larger ships (which can be up to 500m long) do not have enough water to stay afloat in all tidal states. To resolve this 'boxes' are dredged out of the river bed at strategic points; ships are positioned above these so they do not run aground when the tide goes out.

Gravesend has an additional complexity in that this is also the point when river and sea pilots may exchange, so one pilot may be leaving and another boarding at the same time. One pilot described how a team of two pilots would board a large ship, with one setting GPS beacons around the perimeter of the ship and the other using an over 20kg armoured laptop (that has to be brought onboard) to uplink to a satellite so that the pilots can know the location of the ship to nearest 50cm. Visibility on large ships can be an issue, as a full container load can

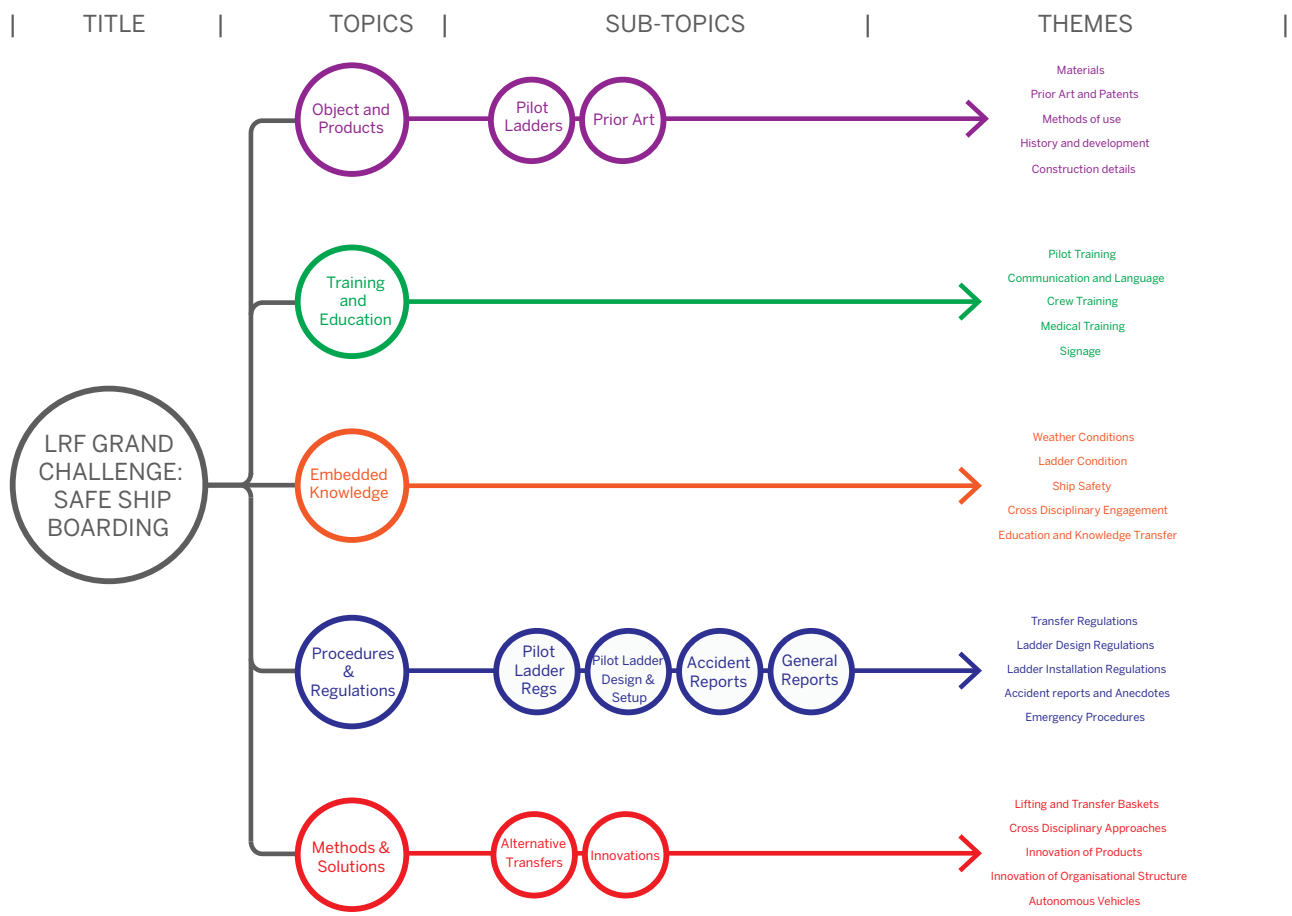
block up to the first 3 miles of vision forwards from the bridge. Knowing that a large, complex pilotage was scheduled for the coming day meant that some pilots may have a sleepless night going over all the details and conditions that might occur the next day.

The RCA team asked whether remote or robotic pilotage was possible and it was confirmed that this is sometimes used at one of the Dutch ports. However, it results in a 70% drop in berthing speeds and the system is still unable to cope with the range of conditions that an experienced pilot can. The team also discovered that Gravesend alone delivers 10,000 ship's pilot transfers each year. The activities of ship's pilots are crucial to an island nation like the UK, with over 95% of goods delivered by ship. This was reinforced by learning that London and the south east of England have a reserve of around three days of petrol and four days of food. With 98% of the country's produce being imported by ship the safe operation of pilot boarding is an essential element of the national infrastructure.

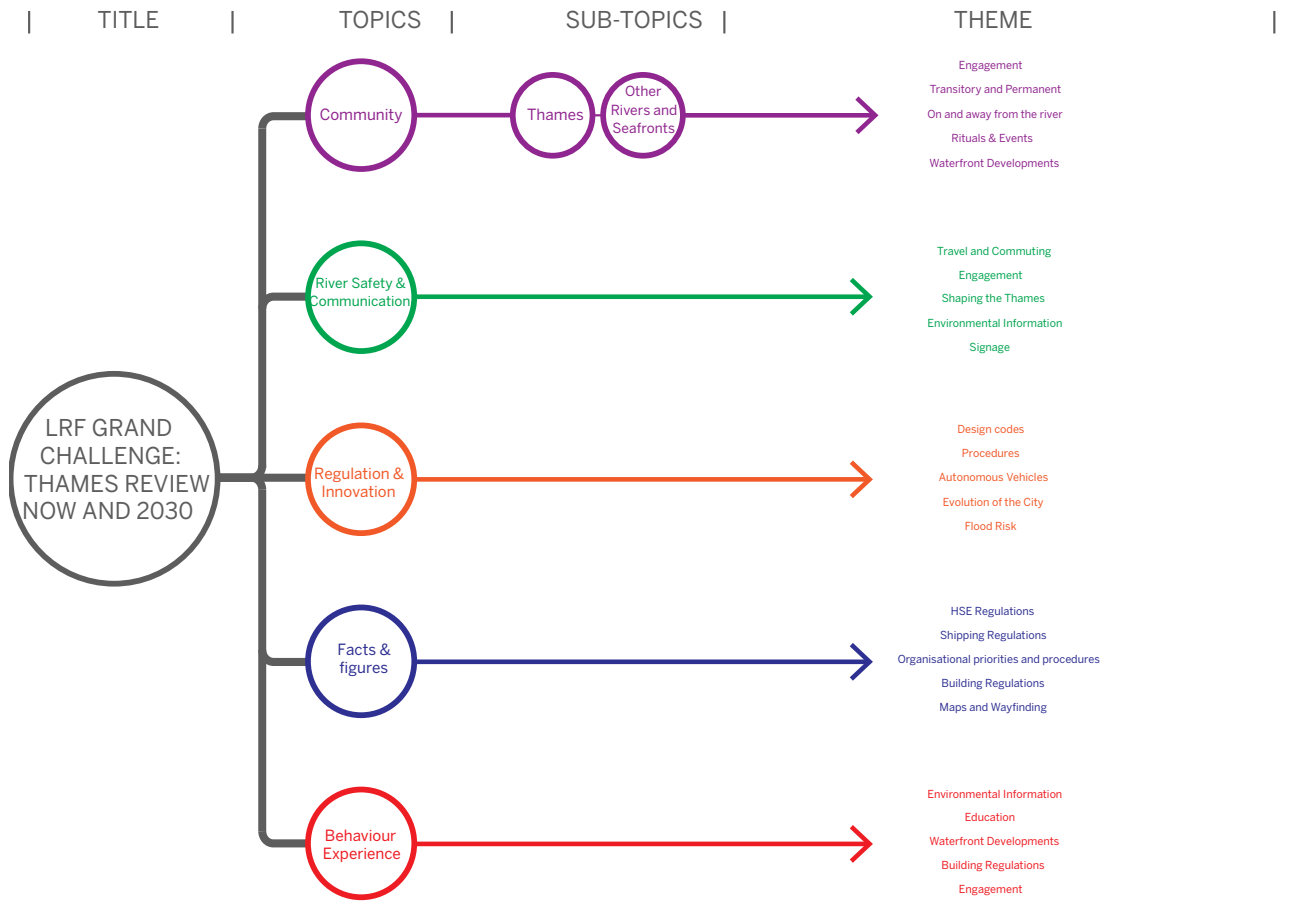
Conclusions & Reflections

These early meetings were arranged to enable early dialogue between the RCA team and the partner organisations involved, allowing for the development of a solid foundation for engaging with these topics, from broad strategic, organisational and cultural concerns to detailed information about equipment and processes. This helped to clarify the partner organisations areas of interest and impact; disciplinary approaches and methods; structures, past projects and any innovations that they had developed. These meetings were also useful in making initial contact with experts and end users in the fields that were being investigated, who were happy to provide a deep knowledge of the cultural and technical elements involved and in fact the number of experts who volunteered their time increased as the project went on. The stakeholders would be directly affected by any potential design solution, it was important to establish these relationships at this early stage so that their knowledge could influence the project through participation. Through this participation at an early stage and volunteering their expertise, each partner and expert in the project engaged in this early project framing research, while enriching our shared body of knowledge on design and safety in maritime contexts. This series of meetings contributed to focusing our understanding of the Grand Challenge, supporting the project and allowing for a deeper appreciation of the background scenario and specific areas of safety improvement opportunity.

The early impressions and preliminary framing of the two areas indicated that there was a clear space for a collaborative, cross-disciplinary approach using design methods and design thinking to attempt to unravel these complex problems and develop some alternative solutions that could resolve safety in high risk, complex situations. However, the two areas of focus needed some research and refinement before involving the design group in the work. To achieve this a number of field trips and meetings were arranged with various stakeholders and interested parties who could answer our questions, inform our understandings and direct us towards a greater appreciation of the details involved in both challenges.



Literature Review Map for Safe Ship Boarding



Literature Review Map for Thames Safest River 2030

State of the Art
The Ecosystem of Risk

Alongside the preliminary work we developed a thorough literature review, informed by our deeper understanding of the grand challenge, which included several specific recommendations from stakeholders and other interested parties that emerged through earlier discussions. We aimed to create a foundation of information to support the design teams in both the initial, generative stage of the project and any future developments that would need more detailed information. The literature review would also serve as a transition point between the early stage research conducted by the RCA team and the teaching phase of the project. Sources included academic papers, magazine and blogs, industry publications, patents, conference proceedings, videos and books. This work served to signpost research areas, act as a repository of information to help designers understand the specifics and context of the projects and included examples of state of the art to show how other projects succeed.

The information in the literature review came from a range of topics, backgrounds and sources was formatted to support the design teams to help them to find the insights to inspire their projects. To help make sense of all of this information, we wanted to design a structure to allow the designers to navigate the literature review and find the most appropriate information that were most relevant to their project work and so encourage and inspire creative risk taking.

To achieve this the literature review was mapped with the main research area of the topic at the head of the structure, with five subtopics that addressed the core concerns of the topics. The subtopics were identified by the research clusters that started to emerge from within the collection of sources. From this, we started to identify some themes in these subtopics, which were used to describe and elaborate on the research clusters and add a level of detail to the mapping (See Appendix 1 and 2 key literature). This descriptive quality was helpful as it allowed us and the participants to understand the broad issues and minutiae relating to the topics, as well as providing an expressive way of engaging with the literature review.

As we were aiming for the designers to use the literature review to drive their initial work and future refinements in a short time span, we developed two maps. These detailed each topic by themes and sub themes, and showed how to navigate the literature review on a granular level. This was also a useful mental model of the research topics, exploring a more strategic overview by showing the areas that participants could engage with and the spaces left to aim for. To support these aims and diagrams we also created a selected literature review guide, which listed each topic and subtopic and used embedded links to direct the designers to the documents. This guide included some unconventional sources including links to organisations' websites, Youtube channels and videos, Facebook pages and groups and Twitter accounts and hashtags.

All of this information was presented to the participants on the first day of the project with an explanation of the overall structuring of the literature review and the information that could be found in each topic and subtopic. Along with this, the mapping of all of the information was

shown using the two diagrams and important documents highlighted with the selected literature review document. This information was all provided to the designers digitally and the literature review was made available to them through a shared digital repository link.

Safe Ship Boarding

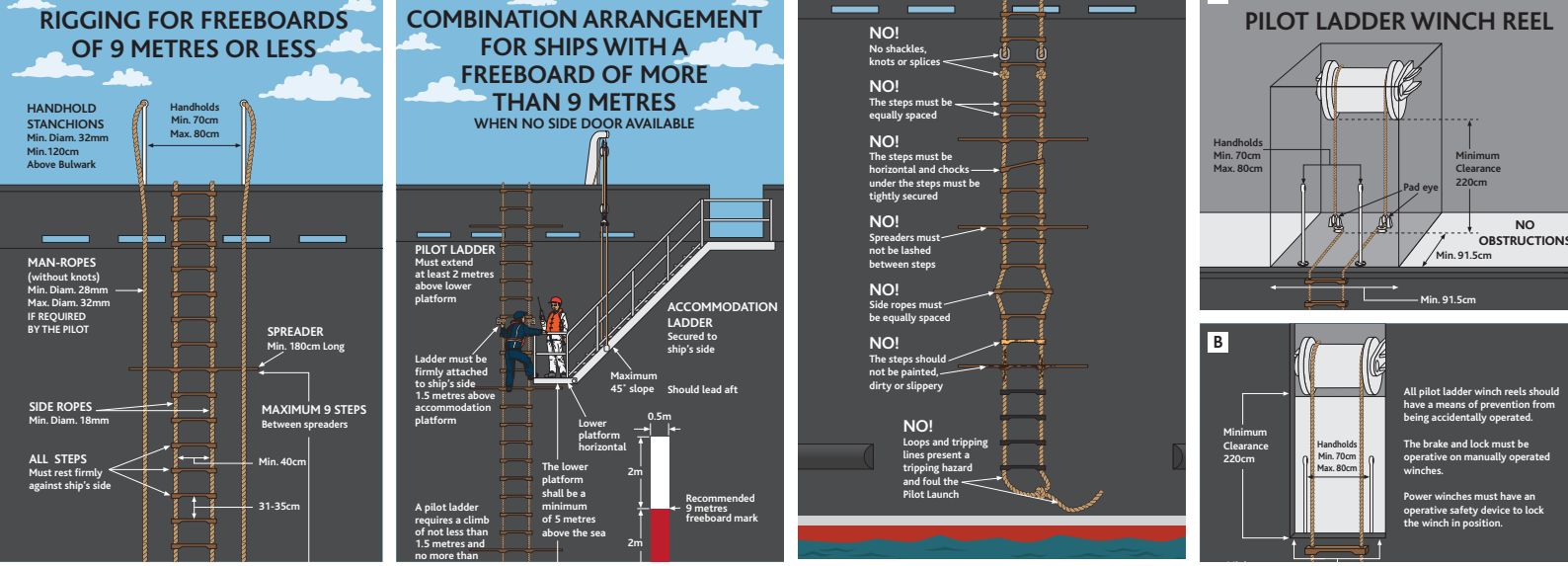
The first topic explored in the literature review was that of Safe Ship Boarding, which focused on how to make the current, traditionalist practices of marine pilots in boarding commercial vessels safer, considering new developments in products, disruptive innovation, organisational structures surrounding this issue and training and education. Again, the organisation of this information into coherent groups led to four subtopics, indicating that there was a range of approaches that could lead to safer methods of boarding ships in high risk environments. These subtopics were Objects and Products; Training and Education; Embedded Knowledge; Procedures and Regulations and Methods and Solutions. The literature ranged from information on what marine pilots actually do and product innovations in boarding ladders to historic patents through to products that were new to market and solutions from closely related industries. It also included technical and regulatory information on the design and development of pilot ladders and how to rig them; statistics and anecdotal reports on pilot accidents and pilot training and education.

Objects and Products

The literature that was gathered for this subtopic was relatively easy to group, as it was all directly related to the objects and products used by pilots to board vessels. Within this subtopic there were two closely related further subtopics – Pilot Ladders and Prior Art. The documents consisted of information on the history and development of the Pilot Ladder, the current state of this object, how to construct, rig and check the ladder, globally agreed regulations on transfer arrangements, and historic innovations that were either unsuccessful or never realised. Through this grouping five themes emerged: Materials; Prior Art and Patents; Methods of Use; History and Development and construction details. This relatively narrow focus within this subtopic was important in providing a solid foundation of knowledge about this artefact, past attempts at innovation, and the ways in which it should be set up by ship crews and used by pilots.

Training and Education

The grouping of this subtopic brought together documents and information relating to the training and education of anyone involved in the boarding of vessels by maritime pilots, as well as future directions for training and education and how to develop effective programmes relating to this. These included safety campaigns by Marine Pilot Organisations, articles on pilot ladder checks by ships crews, information on cold shock and diagrams setting out the most common issues involved with rigging conditions of ladders. This led to a set of themes that described the concerns within this subtopic: Pilot Training; Communication and Language; Crew Training; Medical Training and Signage. This subtopic and themes were useful in identifying existing training programmes, who and what they focus on and important elements that may not have any educational



Detail from IMPA Pilot Ladder Boarding Arrangement Poster, IMPA (© IMPA)

programmes and so need development.

Embedded Knowledge

This subtopic grouped together a range of documents that related to the knowledge and culture that surround the pilot ladder that may not be explicitly stated in guidelines or regulations, along with the culture of pilotage and how this culture can sometimes lead to problems. This included information on rigging and maintenance of the ladder from a pilot's perspective, reports on accidents, marine pilot newsletters and in-depth interviews with pilots. These documents and the themes of the subtopic helped to define the role and culture of the marine pilot, how they work across cultures and disciplines and their tacit knowledge of transfers, environmental conditions and equipment.

Procedures and Regulations

The literature in this subtopic consisted of global and local procedures and regulations relating to the maritime industry in general and more specifically to pilot transfers. As there are a number of areas of focus within regulations, this was split into four further subtopics: Pilot Ladder Regulations; Pilot Ladder Design and Setup; Accident Reports and General Reports. The documents for this subtopic included a slew of pilot transfer regulations, both historical and current; detailed information on the design, construction and rigging of the pilot ladder; reports on accidents ranging from detailed presentations to anecdotes and studies into pilot transfers. From this array of information five quite clear themes emerged – Transfer Regulations, Ladder Design Regulations, Ladder Installation Regulations, Accident Reports and Anecdotes and Emergency Procedures. These documents and themes detailed the volume of regulation surrounding the objects, setup and processes of pilot transfers and the techniques that have been adopted by the maritime industry across the world in an effort to make this dangerous procedure safer.

Methods and Solutions

This final subtopic brought together literature that was in some way related to the development of new methods and solutions to the danger associated with traditional pilot transfer methods, with a further split into Alternative Transfers and Innovations. The former subtopic detailed alternative methods of personnel transfer in related maritime transfer situations and other transfer methods from comparable industries such as aerospace, while the latter focused on driving innovation through technology, organisational structures or cross disciplinary approaches. The documents cover a range of topics, from offshore personnel transfers to oil rigs and wind farms using cranes and personnel baskets, to focusing on human factors in refined transfer methods, specially designed First Aid kits and self-driving boats. This led to the development of five themes, Personnel and Transfer Baskets, Cross Disciplinary Approaches. These documents and themes highlight that there are a number of alternative methods and solutions to personnel transfer and that innovation in this area is being influenced by technology and design considerations.

RNLI crew members (© RNLI)

Thames Safest River 2030

The second topic explored in the literature review was the Thames Strategic Report, which focused on how to make the River Thames the safest in the world by the year 2030, considering the future transport, housing, infrastructural and technological development over the coming decade. The Thames Report helped to contextualise the vast range of issues that could impact upon the future developments on the Thames and the information that was gathered reflected the rather wide ranging and fragmented nature of how to achieve this high standard of safety.

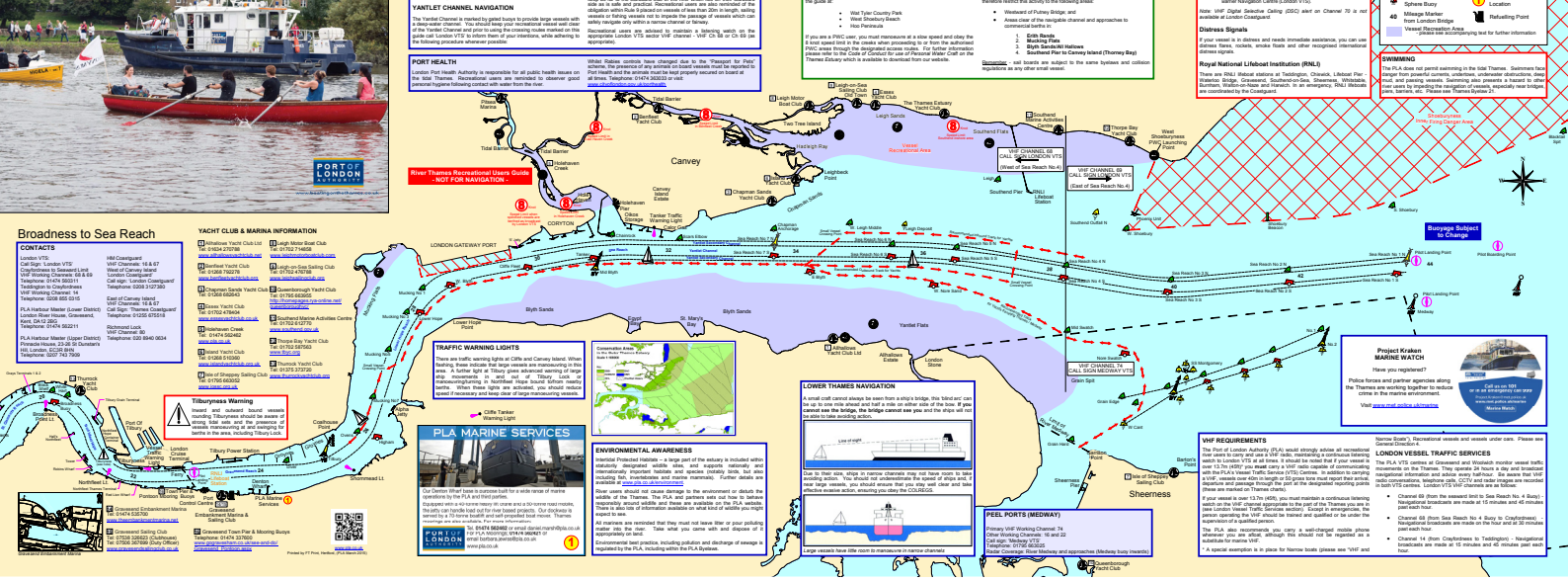
The literature that was gathered ranged from detailed maps, statistics of use of the river, technical information and regulations of built environment and shipping, to reports on the development of the Thames Gateway, educational programmes and behavioural change through education, community engagement and activity on the river to good and bad examples of riverfront development from across the world, academic reports on their social impact and the use of emergent technologies on waterways. In organising this information into similar subject areas and groupings a number of subtopics emerged that suggested some distinct methods of engaging with safety on the Thames and rivers worldwide.

Community

This encompassed a range of interpretations of Community on the Thames and other waterways and included specific information on the array of events, communities and groups that use the Thames for intermittent activities; historic events on the Thames that bring communities together; the development of new communities on the Thames and waterfront developments and communities enabled by waterways from across the world. From these documents and information five main themes that helped to describe the areas of interest in the topic emerged, which were Engagement; Transitory and Permanent; On and Away from the River; Rituals and Events and Waterfront Developments. These documents helped to show the range of events and communities that take place and live with the Thames as well as approaches to involving and developing communities in comparable projects across the world.

River Safety and Communication

This group of the documents dealt with various aspects of safety on the river and how to communicate this information, including details of the environmental safety work on the Thames; the future of river travel and its implication for river safety; the role and work of the RNLI on the Thames and beyond through educational programmes; the effects of past infrastructural developments, such as the Embankment and future mapping publications, such as the Thames Vision report and the Thames Gateway Delivery Plan. From this five main themes were identified: Travel and Commuting; Engagement; Shaping the Thames; Environmental Information and Signage. These documents detailed the past interventions and future plans for the development of the Thames and the implications this could have on safety; the ways in which the RNLI operate on the river and in terms of education and the past environmental work on the river and how future



Thames Estuary map, PLA (© PLA)

developments need to consider this aspect too.

Regulation and Innovation

This subtopic consisted of literature that involves the regulation of the River Thames and other waterways and the ways in which these may be disrupted by technological innovations. This included detailed information on the design codes for riverside structures, such as jetties; the regulations surrounding the launching of RNLI boats and the use of commercial vessels; the future of city waterways and water quality and the use of new technologies such as unmanned drone boats and the possible necessity of a second Thames Barrier. From this collection five main themes became apparent: Design Codes; Procedures; Autonomous Vehicles; Evolution of the City and Flood Risk. The range of documents detailed the existing regulatory framework that projects might have to engage with; the future technological development of the city itself and how innovation can impact upon engagement with the river through autonomous vehicles and upon the river itself through flood prevention and water quality measures.

Facts and Figures

The literature in this subtopic was far easier to group than many others, as all the documents consisted of maps, statistics and reports that would be useful in providing an understanding of the geography of the Thames and reports related to the use of Thames, as well as some repeated information such as design guides. Again, five main themes emerged which were HSE Regulations; Shipping Regulations; Organisational Priorities and Procedures; Building Regulations and Maps and Wayfinding.

The range of the literature in this subtopic means that there was some overlap with the previous subtopic, however with less of a focus on the regulatory framework elements and more attention paid towards the useful statistics and geographical information.

Behaviour-Experience

The final subtopic for the Thames Review topic grouped a range of papers and other documents that had implications on how people engage with the riverfront such as reflection on behaviour and self-knowledge; the impact of educational programmes; how to develop a riverfront for social impacts and previous training and skills. Through this five key themes came to the fore, again with some overlap with earlier subtopics: Environmental Information; Education; Waterfront Developments; Building Regulations and Engagement. This range of literature directed thinking towards educational programmes, the built environment and psychology and how these can impact upon river safety by changing behaviours through experience and self-knowledge.

RNLI crew members and volunteers (© RNLI)

Developed Understandings & Findings

The two main topics that make up the Lloyd's Register Foundation Safety Grand Challenge share a number of commonalities. They are both complex issues with a number of stakeholders, interested parties and regulatory bodies involved and are generally difficult problems to address, let alone solve, topics often known as 'wicked problems' (Rittel & Webber, 1973) These topics are linked by their connection to waterways and the high stress situations that these can raise; the involvement of communities, their shared knowledge and embedded cultures and issues surrounding trust, collaboration and the role that large organisations and their structures play in the involvement of an array of global, national and local interested parties with differing aims, organisational inertia and commercial pressures. There are also a number of elements that differentiate them, such as differences in attitude to innovation in their industries; support through education, equipment and community outreach programmes and an interest in updating cultures to prevent accidents.

Safe Ship Boarding is an extreme user case study in the development of managing risk in a high stress situations. This is a recognised design strategy to focus on an extreme group of users so that by tackling the issues these individuals face the benefits can cascade down to other users in less extreme situations. Ships' pilots are a small, tightly knit community of pilots working and living on the water, using specific procedures and objects in transferring between vessels. While improvement to the pilot ladder seemed to be an obvious starting point, the pilot community tends towards traditionalism and is resistant to change. This can be shown through the slow, incremental improvement of the objects and processes and through the concept of "grandfathering" (Oxford University Press, 2017). Many pilots stated that they liked most aspects of the ladder and during our first discussions seemed closed to innovation.

In conjunction with this is an unstable industry and environment of shipping and water, where there is a massive variety in port regulations, the design, quality and age of a vessel, the abilities and reliability of the crew and the changeable environmental conditions, all of which impact upon the process. There are pressures facing the pilots and captains of the vessels from all parts of the world, including financial concerns, time demands and even seasickness, which can impact on vessel and equipment maintenance and crew experience. Despite efforts to regulate the ladder, rigging and the process of transfer implementing these directives from organisational bodies seems to take a long time. There are also ways to circumvent these regulations, and pilots may not always report bad ladders or rigging. There are some concerns about the support, training and equipment that pilots have – there is no minimum level of fitness required to do what is a physically demanding job and no maximum retirement age; there is apparently little appropriate medical knowledge or standard equipment onboard cutters and in the case of a search and rescue operation, in some scenarios there was confusion over who to call and the information that they would need.

The literature review on Safe Ship Boarding found some useful information from Safety of Lives at Sea (SOLAS) and Confidential Reporting Programme for Aviation and Maritime (CHIRP) websites, alongside the IMPA on self reported accidents and gave some breakdowns on the more common types of accident and failure modes. In terms of design-led innovation we found few examples of a concerted project-based effort to tackle ship-to-ship boarding and especially from a pilot transfer perspective. There were some examples of emergency evacuation from ocean liners and of particular interest was the new cutter designed for offshore wind farms that uses sophisticated seastate compensation mechanisms. However, the operational dynamics and high cost of this equipment made its more widespread use for transfers unlikely. Through our stakeholder engagements it was suggested to look at equipment used by the Special Boat Service for boarding vessels, but apart from speculating about magnetic ladders we were unable to explore this further - undoubtedly due to the confidential nature of the operational techniques and technologies.

The other topic in the Safety Grand Challenge looked at how to make the Thames the safest river in the world by the year 2030, considering the expected population increase between Tower Bridge and Gravesend, the large number of clubs and communities working and living with the Thames, the intention to develop transport links across the river to cope with higher demand and the fact that there are no plans to increase the amount of RNLI stations on the river. This challenge includes the role of education, communication and place-making in developing knowledge and social engagement within communities to prevent accidents through learning how to respond in emergencies via experience.

This topic has a willingness to embrace innovation to develop solutions to this multifaceted problem area, with an interest in using emergent and future technologies to disrupt current methods and structures, both physical and organisational. Solutions aim to tackle pressures and environmental concerns, such as increased sewerage and wastewater impacting upon the water quality of the Thames and climate change leading to rising water levels. An issue in common with the previous topic is that of organisational inertia – there are regulations for local councils, who have a duty of care to their residents to educate them and prevent waterbased accidents; however many seem to avoid these responsibilities with few repercussions.

The state of the art for Thames Safest River 2030 was invaluably aided by the Thames Strategic Review, information provided by the RNLI and the suggestions of the other stakeholders. Looking at a broader range of influences, there are a large number of lifesaving on-water products and projects, such as autonomous aquatic boats, products made from materials found in and around the river and past projects from IDE, including a lifesaving drone designed in collaboration with the Sydney Surf Lifesavers during the 2013 RCA GoGlobal project and a specialist inflating lifejacket for lifeguards rescuing a panicking swimmer. Our Grand Challenge focus was in understanding human behaviour around water linked to life saving innovations and in this respect there was less material specifically covering the river Thames.

This detailed research into the relevant literature was informed by previous field trips and meetings with stakeholders, which helped to broaden our understanding of both aspects of the Safety Grand Challenge and gain a deeper knowledge of the complex issues that affect them and to identify how design could help. These include topics such as cultural and organisational inertia, wariness towards change, regulatory frameworks and guidelines, the effect of the built environment and demographic shifts, psychology and educational intervention and the role of disruptive technologies. This initial understanding then allowed us to investigate the topics with more rigour, leading to a number of research clusters and themes. Despite the apparently differing nature of the topics and problems it became clear that there were a number of common issues across both of them, that could be addressed by applying design methods and thinking in a cross disciplinary, collaborative framework. We felt that this approach, combined with the involvement of creative risk and in and collaboration with partner organisations, would be a productive way to identify problem areas and generate innovation.

GoGlobal Prototype (©IDE 2013)

Design Research Timeline of Events

Through the early stakeholder meetings, engagement with expert users and curation of a literature review with the emergent research clusters and themes, we had developed a good foundation of understanding. This knowledge would be passed onto the postgraduate design teams at this stage of the project through the literature review and the continued involvement of the RCA staff in delivering presentations, leading design method sessions, group tutorials and presentation feedback. The challenge at this stage of the project was in how to build a collaborative academic-research project and organise a set of relationships that enabled design impact in the field as well as delivering academic value. The role of interdisciplinary engagement was important to the success of the project, both in the makeup of this group of designers and in engaging with stakeholders, partners and experts. In this project, interdisciplinarity was important in terms of the designers, as this variety of backgrounds, skills, methods and ways of thinking would help to create novel, rigorous solutions. Experts in both Safety Grand Challenge topics also came from a range of backgrounds, with different understandings and separate cultures. This interdisciplinary mindset was also important in engaging with the stakeholders and interested parties - the project format allowed the designers to engage with all of the stakeholders, and also encouraged greater interaction and cross pollination between these stakeholders during meetings, presentations and feedback sessions.

As the interdisciplinary nature of the project was so integral, the recruitment of the designers was designed to coincide with AcrossRCA (AcrossRCA, 2017), an institutional initiative held in late October every year which aims to connect postgraduate designers and staff across all Schools, Departments and Programmes at the RCA. This is framed through a number of diverse five day projects running at the same time, all of which are inherently interdisciplinary and collaborative and most of which encourage participants to engage with new ideas, approaches and skills. Postgraduate designers have in the past tended to respond to this structure in a positive way, saying that it has given them the opportunity to meet postgraduate designers from a variety of disciplines and work on new projects in ways that are beneficial and influence their future work and methodologies. We felt that this was an ideal way to recruit our cohort of designers and to frame the initial part of the project with them. We organised 32 postgraduate MA and MSc design postgraduate designers into eight project groups, working in interdisciplinary teams of three to four from eleven disciplines including Innovation Design Engineering, Information Experience Design, Global Innovation Design, Visual Communication, Design Products, Service Design, Vehicle Design, Design History, Architecture and Sculpture.

The RCA design-research team developed a programme that would enable the designers to understand and engage with the problem area in this initial five day AcrossRCA project and beyond. As this time scale was very concentrated, the programme maximised the support that the participating designers were given in developing their understanding of the problem areas, their engagement with these topics and their creative outputs. This programme focused on a few key elements,

such as establishing a solid foundation of knowledge relating to the problem areas, creating and applying effective design methods during sessions to help generate ideas and frame the problems, allowing space for each group to develop their projects through self directed discussion, design and research sessions and the regular guidance of tutorial sessions and group presentations, crits and feedback sessions.

This was framed as an action research approach which consisted of (1) facilitating the postgraduate designers and stakeholder engagement, (2) inputting the insights from the literature review and early stakeholder meetings. The postgraduate designers acted as participatory designers, bringing stakeholders into their projects for suggestions and expert insights. This meant that our research methods were a combination of action research and participatory design research. Action research (Lewin, 1946) is a circular research method that we deployed using feedback loops driven by participatory observation to inform and adjust actions primarily used by the research and tutoring team. It works through a circular set of stages including plan, act, observe and reflect, and in practice this coonected fluidly through the literature, state of the art, stakeholder and partner connections, concepts, design and prototypes testing during the process. The design teams used what some consider to be a modification of action research - participatory design research (Spinuzzi, 2005) - which develops a close relationships with users and stakeholders to test and develop insights through design concepts.

There was a focus on the role of risk in the project, which is an important commonality between the Safety Grand Challenge topics, where the overall goal is to manage and decrease the risk in transferring pilots or on the Thames and in London for 2030. Creative risk is also embedded in the structure of the project itself - this could be the risk in approaching a subject outside of one's own expertise, the risk in collaborating with people from other disciplines, the risk of creative methods failing to deliver realisable solutions and the risk of using methods in an unfamiliar context. By encouraging this inherent creative risk within this hybridised action research/participatory design structure, we hoped that the designers could develop a range of solutions that would address the concerns of partner institutions, the cultures of the industries involved and the context that the outputs would be used in.

Throughout the course of the project, from November 2016 to February 2017, the postgraduate designers had access to the tutor teams on a weekly basis and were also supported by some of the stakeholders for technical guidance and advice on their concepts. This provided the tutor team an opportunity to regularly monitor their progress that would continue until the end of the project, when a showcase and presentation of the projetcs would be held at the Collcutt Building in the City of London, where the Lloyd's Register Foundation is based.

Groups of teams in the brainstorming session (© Chang Hee Lee)

AcrossRCA

Day 1 - 31st October 2016

The first day of the AcrossRCA Lloyd's Register Foundation Safety Grand Challenge was a chance to familiarise the designers involved with the tutor team, the overall project and the two main aspects, the organisations involved and the important literature that would help to guide their understanding of the project.

The day started with an overall introduction to the project by Prof Hall, and Dr Ferrarello, who contextualised the work within the structure and background of the School of Design, its disciplinary diversity and past outputs that had come about through commercial partnerships and research projects with charitable and grant funding institutions. He went on to frame the overall aims of the partnership as looking to innovate within the maritime context to reduce risk in high stress situations, with the two projects engaging with this through two slightly different, but closely related topics.

Following this, Research Associate Mike Kann presented the research inputs which had led to the understanding of the state of the art through the literature review. This explained the two different projects, the methods of engagement that had been used and the breadth and depth of understanding the concerns involved at both the organisational and operational levels of our collaborating partners and stakeholders. He explained how each project had a range of documents, through which clusters of research formed into topics. Each topic was introduced and their descriptive themes were explained before the designers were shown the maps of each literature review. This showed how all the elements related to each other and different ways that the designers could navigate them. Finally, the designers were provided with an online link to the literature review, diagrams and the selected literature review document.

Towards the end of the morning the designers discussed their initial understandings and ideas around the projects, concepts and directions started to emerge, which allowed them to decide which project they wanted to take on.

In the afternoon Chris Hoyle, a marine pilot and Neil Withers, RNLI Thames Operations Manager, gave detailed presentations. These covered what they do, their particular specialities, their involvement and engagement in each topic, the cultures involved, general aspects that could be of interest, and the worries, concerns and questions that they had. The presentations continued with the RNLI Innovation Lab representatives, who described the Grand Challenge and the scope that governs the RNLI Innovation Lab. As well as providing a tangible context to the topics, they provided a wealth of detailed information and inspired the postgraduate designers, who raised a number of questions that addressed the general topic area and specific elements within the topics. The last event for the day was a breakout session for informal chats and the chance to use a pair of Google Cardboard VR sets to view and experience an RNLI exercise on the river Thames in an immersive 3D experience (RNLI, 2017).

Day 2 - 1st November 2016

The second day of AcrossRCA focused on supporting the designers in developing their

Groups of teams in the brainstorming session (© Chang Hee Lee)

concepts through the use of traditional and innovative design methods. Through the use of a variety of tools for generating, filtering and selecting ideas and by having a clear end-of-day goal of a five minute presentation, the group of designers were engaged with the design process from an early point, with the research feeding their practice.

The morning session concentrated on each group conducting a brainstorming to generate hundreds of ideas for their project. This session had a few clearly defined rules: focus on speed and volume, no judging of ideas, bounce ideas around and draw, don't write. Along with this standard brainstorming set-up, there were also a few other design methods used to direct brainstorming and encourage a large number of concepts, including 'Rotating Tables' and 'Design Exorcisms.' 'Rotating Tables' is a tool to help introduce outside influences to the brainstorming session through the use of a range of card decks, with one deck and only thirty minutes at each table. The themes of these sets can vary, but in this instance the designers were provided with a directions deck (loop ahead: bend the rules; truck rollover: find the limit), a character deck (the old one, the teenage one) and a constraints deck (use emerging technology, make it from one material). Through the use of these card sets, the designers' thinking was challenged, so the concepts they developed were novel and responded to these external influences.

This generative session was finished with a 'Design Exorcism' session, which is a method used to extract all of the concepts that the designers may have filtered out and hidden during the earlier stages; this could be because the designer felt that they were embarrassing, uninspiring or ridiculous ideas. However, as one of the established rules of brainstorming is not to judge, all of these ideas should be recorded and discussed, as they still had value - they could inspire other designers or identify an aspect of the project no-one else had thought of, so leading to a new direction. Through the use of these methods, each group generated between two and three hundred initial concepts. The next stage of the process was to use filtering and assessment processes to evaluate these concepts to identify the strongest three to develop further.

The afternoon session used three main design tools to evaluate the initial concepts developed, in the morning along with experience and discussion from within the design teams supported by research team inputs. These mapping tools were developed to extend each concept and included a 'User Experience map' which recorded the use process, a 'Gravity map' that checked core design needs and a 'Selection tool' that allowed comparisons to be drawn. These helped to guide the designers and clarify each concept through the lens of the user's experience in order to assess the strengths and weaknesses of the concept's and identify the most promising three.

Field trip to Gravesend, testing RNLI training equipment at the lifeboat station (© Laura Ferrarello)

core ideas in relation to certain criteria and a tool to help gauge the major and minor contributing factors to the success of each concept. Through this reflection on their own design methods, their colleagues' projects and the evaluation of their group's ideas, the designers were able to make an informed decision on which concepts had the most potential for development and were most suited to the context. From this they were then able to select three concepts to take forward to the end-of-day presentation.

Day 3 - 2nd November 2016

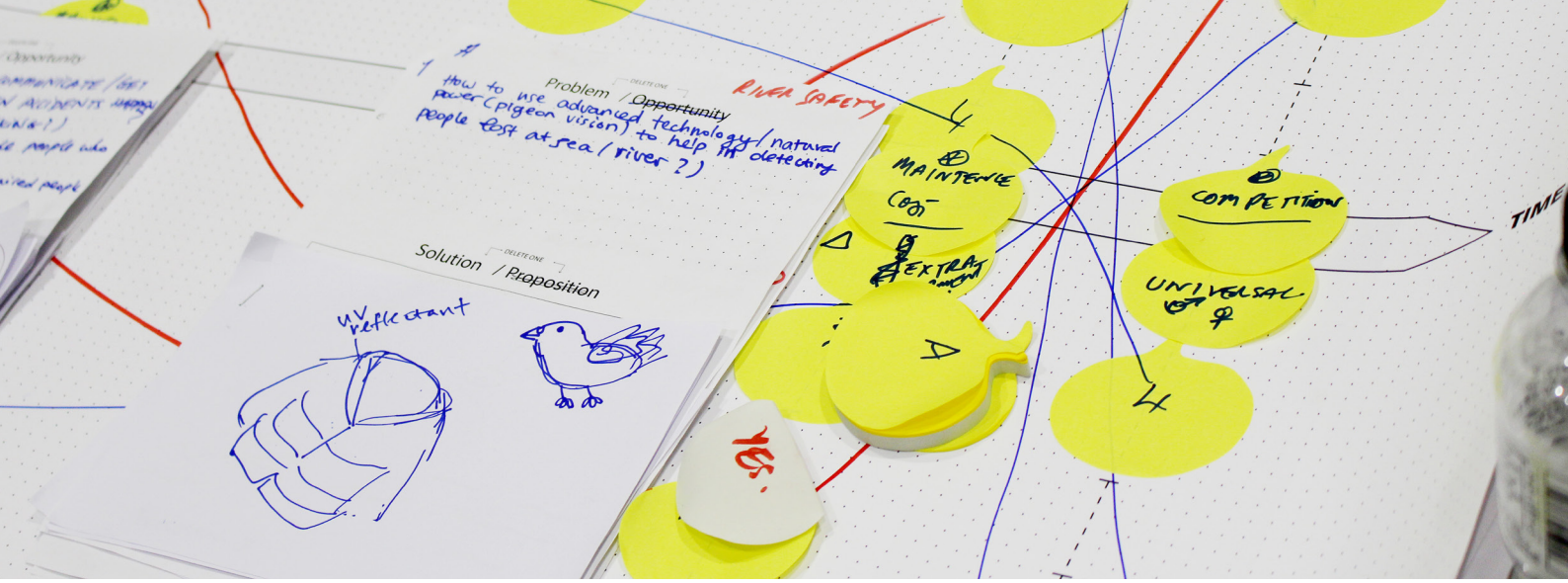
The third day of the programme involved a field trip to the PLA headquarters in Gravesend. The intention of this was to provide some first hand experience of the problem areas, the contexts in which their work may be used and some face to face contact time with some of the stakeholders involved in the project. This first hand research experience would also enable the designers to develop ownership of the project by directing questions and concerns towards their concepts, allowing the research to feed into their design concepts.

The group of designers was roughly split into thirds, making groups of about ten, with each group at one of the three activities for about half an hour before rotating to the next sessions. The first activity was a half hour presentation and Q&A session with marine pilot Hywel Pugh and PLA deputy harbourmaster Simon Phillips. Pilot Pugh provided information on the role of pilots, pilot kit, the ladder itself and its use in this method of transfer, weather conditions, relevant organisations and personal experiences of being a pilot, as well as answering the designers' questions.

The second activity was a discussion with Gravesend RNLI Crew in their station and visit to the RNLI Gravesend pier to inspect their equipment and vehicles. Station master Jason Carroll explained the role of the RNLI, the background and training of the volunteers, the procedures involved in responding to emergencies and some relevant organisational methods used. Helmsman Dave Parry took the group to the pier to look at the equipment and vehicles, but only after safety equipment was worn. He explained in detail the equipment on the boat, in terms of power and control systems, flotation devices, communication and mapping equipment, search and rescue tools, emergency gear and medical kits. He also explained the details of answering emergency calls, such as getting people on board the boat and where to lie injured people flat.

The last was a visit to the PLA VTS room. This was led by Deputy VTS Manager, Thomas Southall and focused on issues of organisation of the Port and the part pilots play in this. The designers were shown some of the equipment used in the sea and river management activities, including Automatic Identification System (AIS - real time displays of vessel positions,) radar, weather conditions and variances in the tidal swell height and speed. Mr Southall explained how these systems work, the role that the VTS plays and how this impacts upon the maritime industry and marine pilots.

At the end of the morning, all three groups met again and sat to discuss some of their insights, as well as ask further questions of Hywel Pugh and Simon Philipps. There was also a first tutorial session, where the designers were asked to relate the insights that they had from



Detail of User Experience Map (© Chang Hee Lee)

these experiences to the concepts that they had developed through the brainstorming sessions. After this, the designers were asked to spend the rest of the day in design work that was informed by the experiences and knowledge that they had gained that day.

Day 4 - 3rd November 2016

The penultimate day of the week focused on the guided development of the concepts that the designers had refined during Wednesday afternoon, with the end of the day set aside for short presentations with a physical prototype to the entire cohort of designers and staff. The aim of this was to focus each group through contact time with the researcher-tutors and to put in place a public forum for presenting, explaining and defending their work.

The tutorial contact time comprised of two teams, the first of which was made up of Laura Ferrarello and Mike Kann and focused on cultural elements that could affect the designers' projects, such as aesthetics, culture of use, societal issues, education and infrastructure. The second tutor team was made up of Matt White and Chang Hee Lee, focused on technical elements like material selection, practicality, ergonomics, application and use cases and how these could affect the progress and development of the project. Each tutor group spent half an hour with each design group and through the combination of skills and interests helped to address this range of essential elements. The researcher-tutors helped to direct certain aspects of the projects, raising concerns where necessary and providing general feedback to help facilitate the designers to mature their own project work.

After these tutorials, some time was set aside to allow the design teams to engage with this feedback and act accordingly in developing their projects. While this was done using similar techniques to earlier in the project (sketching/discussing/researching,) an important element of this was the instruction to work on a physical prototype that would support the Pecha Kucha (Pecha Kucha, 2017) presentation at the end of the day. These physical objects ranged from models of vessels to show how products would interface with it, to more detailed models of products themselves - however they all helped to illustrate the products and their context and made sure that the designers engaged with the physical concerns of their projects.

Towards the end of the day the teams were asked to present their projects to the entire group of designers and researcher-tutors in a format like a Pecha Kucha, where there are 20 slides that advance after 20 seconds, so the whole presentation lasts for about 7 minutes. This format encouraged the teams to distill the context and essence of their products down into an efficient presentation, identifying and communicating the most important elements and features of their concepts. This additional level of reflection on their projects and practice would also help to direct their design thinking, project development and future presentations. Once each presentation had finished there was a short feedback session from the entire group of staff and designers, as in most cases this was the first time that the designers had seen all the developed concepts.

Day 5 - 4th November 2016

The final day of AcrossRCA was the culmination

Pilot Hywel Pugh demonstrating a pilot's jacket with one of the postgraduate designers (© Chang Hee Lee)

of this five day programme and focused on the afternoon of presentations and feedback from a jury of twelve comprised of people in senior positions in our partner organisations including the Lloyd's Register Foundation, RNLI, UKMPA, PLA, Thames Strategic Review Team, the Foundation for Science and Technology (FST) the International Maritime Rescue Federation (IMRF) and Confidential Reporting Programme for Aviation and Maritime (CHIRP).

The morning session left the designers to develop their concepts if necessary, but was intended to be used for the development of a new physical model and presentation, refined by the feedback given to each group by the researcher-tutors and their peers. These presentations would showcase the concepts and products that the designers had developed and delivered throughout the course of the week through the application of design methods, design thinking and practice-based research and how they had tackled important elements in their topics, including human factors, equipment, materiality or procedures. The expert jury members were all embedded within one of the main topics in the Safety Grand Challenge through operational or organisational involvement in the many aspects that affect these areas. Due to this involvement and experience, they could provide detailed feedback, critical comments, expert suggestions and advice on how to progress. This meant that it was important for the designers to produce something that explained the problem areas they were trying to address, along with the context and the details of their projects. This presentation served a number of purposes - it would help the design teams to clarify their final concept (both to themselves and the jury,) showcase their work in overview and detail in a formal setting, demonstrate their ability to work across disciplines in novel and difficult areas and allow them to engage with experts in the field and nurture relationships that might be useful in directing future developments.

These presentations not only showcased the projects and deliverable outcomes of the week's programmes, but the obvious engagement with topics, contexts and the human elements involved in these problems helped to communicate to the jury that these designers were working within the culture of the industry through first hand experience and quality interactions with partner institutions and experts. The feedback to these presentations was overwhelmingly positive, with the eight concepts' variety, novelty in innovation and level of development impressing everyone, especially considering the time frame involved. Every group was excited about the possibility of continuing with their projects over the next four months.

November 2016 to February 2017

After the AcrossRCA week the project continued with weekly consultation for the design groups with the projet research-tutor team. This allowed us to support development of concepts and prototypes up to proof of concept level. It also allowed us to observe the development of the design concepts with feedback from project stakeholders and compare that to research we had gained from the exploratory field trips and literature review. This was all brought together and focussed into the design team reconsultations and reviews.

Thames Gateway (© Ashley Hall)

The River Thames from the PLA Pilot Cutter (© Laura Ferrarello)

We carried out two major progress review sessions where the project partners and stakeholders were invited to participate and provide interim feedback. The first session held on the 25th November 2016 focussed on making sure a single concept had been developed with a promising argument for safety improvement through innovation. The second session held on 11th December 2016 consisted of assessing the development of the final concept before the designers began manufacturing their prototypes and functioned as the sign-off stage for commissioning parts, components and assemblies. This culminated in a symposium held on the 21st February 2017, where the design teams presented their completed projects to industrial stakeholders, a prize jury and a public exhibition called "Design for Safety," which opened on the same day and displayed the design innovations. The exhibition was open for a week and became an occasion to extend existing networks and gain industry feedback and gauge potential impact.

As a consequence of the "Design for Safety" success the exhibitors was invited to participate to the International Maritime Pilot's Association (IMPA) event open to pilots from all over the world. The reception was held at the IMPA headquarters onboard HQS Wellington o the Thames and took place from 8th to 10th March 2017.

On 10th March the exhibition opened for a month at the Lloyd's Register Technology Centre in Southampton followed by an exhibition at RNLI headquarters in Poole.

Beside these two major events we received interest from different parties among the partners and stakeholders, who were keen to take forward the process we started, which is to introduce design as an effective method to reduce risk and increase safety.

Field Trips

RNLI Innovation Lab, Poole

On Thursday 17th November 2016 thirteen postgraduate designers and three members of RCA staff- Prof. Ashley Hall, Dr. Laura Ferrarello and Chang Hee Lee - visited the RNLI Headquarter and Innovation Lab in Poole. The day started with the postgraduate designers and staff boarding the RNLI Shannon class lifeboat to reach the Valiant ship docked in the Poole bay. After puttion on RNLI life jackets the group boarded the ship; it was the first time postgraduate designers could experience the "pilot's vision" of the ladder. On board two RNLI staff members gave a wide range of information regarding the equipment the pilot wears to help a safe transfer, including in rough weather conditions. RNLI staff showed the set of hooks the pilot is equipped with and the safe way to walk on the pilot boat to avoid accidents when approaching the ship. As a consequence of the first hand experience postgraduate designers empathised with the pilot. The RNLI trip offered, indeed, the opportunity to understand and focus the problem. Postgraduate designers asked many questions related to the concept they were working on.

Once disembarked RCA designers and staff headed to the RNLI Innovation Lab where Innovation Manager Dr Will Roberts gave a presentation that illustrated the Innovation Lab role, tasks and ambitions to increase safety along UK costs. As single group the designers had the opportunity to discuss their concepts

The River Thames from the PLA Pilot Cutter (© Laura Ferrarello)

together with partners; they generally and gain expert feedback.

The visit continued under the guidance of Innovation Lab Project Manager Tim Robertson, who took the group to the RNLI college facilities. The group visited the in-house All-Weather Lifeboat Centre, where the Shannon, Tamar, Severn, Trent, Mersey, Tyne, D, B, E class and Inshore Rescue boat (RNLI Lifeboats, 2017) are built. The Centre offers: a component manufacturing area, a launch and recovery boat storage area, a print and preparation area, tools and equipment storage (RNLI Lifeboats, 2017).

The visit then continued to the Sea Survival Centre, which includes a pool and wave tank (25m x 12.5 m and 4 m deep), a jump platform and a full mission bridge simulator for lifeboats and commercial vessels. The Centre trains RNLI volunteers and staff from all over the UK (RNLI College, 2017). It is also used for commercial training to award certificates.

PLA Thames Field Trip

The visit then continued to the Sea Survival On 1st December 2016 three RCA members of staff - Prof. Ashley Hall, Dr. Laura Ferrarello and Robert Pulley - and sixteen postgraduate designers boarded a Port of London Authority (PLA) Pilot Cutter at Putney Bridge Pier. PLA Deputy Harbour Master Upper Nick Evans and two members of crew took the group up to the Greenwich Peninsula. The group disembarked at Embankment Pier. During the trip Nick Evans described the main points of "The Thames Vision", which is the Thames "framework" PLA produced in 2015. The Thames Vision offers a comprehensive description of the river Thames as a complex environment that sees people and nature as a whole. The report, indeed, covers topics like natural ecosystems and heritage, transport, sport, communities and culture, inland freight, port and infrastructure and residents (PLA, 2017), all linked through the same network. Evans described to the postgraduate designers the ambitions PLA has for the river in relation also to the problems the river, and those living on it, currently face. The report is a strategic challenge that makes problems triggers of solutions. From the ship wash affecting Thames inhabitant, to Transport for London's ambition to include the river in its network and safety/rescue procedures operated by PLA partners, postgraduate designers learnt about the PLA role and governance on the river. Logistics of rescue operations have been a main point of discussion, regarding which PLA has a specific role in coordinating operations among the partners (RNLI, Met Police, London Fire Brigade, etc). Postgraduate designers learnt how a rescue operation works and which are the most common events and behaviour when people fall in the water. The field trip offered a new vision of the Thames and London, centered on the river; postgraduate designers could see the city from the eye of the river. To help rescue operations bridges' pillars are provided with emergency equipment, like chains, people can use to save themselves and wait for help.

PLA Headquarter London

Project Coordinator Laura Ferrarello and five postgraduate deisgners visited the PLA Headquarter in central London, near Tower Bridge. The group met Katherine Riggs, Director of "The Thames Vision", Nick Evans and another member of PLA staff. Riggs gave more details on the report, focusing on those aspects that aim to tackle future problems. She indeed described how PLA intends to solve the current challenges by offering an exhaustive description of the river current use, river banks included, and of the future plans related to urban mobility, leisure and cultural activities. Katherine described as well how PLA finds it difficult to monitor all the events real time, which could prevent hazards.

The visit helped to ground the postgraduate designers' concepts. The meeting, indeed, gave some ground data to support the validity of the projects.

Pilot Ladder at the Port of London (© Ashley Hall)

Designs for Reducing Risk

The combined Action Research and Participatory Design research practice methods were successful in supporting the designers in developing a varied range of innovations. The common element to the eight projects was a strategic approach to the main concerns of the Safety Grand Challenge: risk, design and safety.

Due to these concerns the eight projects evolved, changing parameters and finding new aspects of the problems to frame and tackle in order to find the best, most cutting-edge solutions that would tackle the key areas of the project. This expansive stage saw the designers and stakeholders working more closely to identify and solve real life issues that might affect their projects, while the RCA continued to support the designer with regular tutorial sessions. This participatory approach was augmented by intermediate presentations by the designers to the stakeholders on 25th November and 12th December 2016.

This helped the designers to consider the global and local contexts of use, object scale and manufacturing techniques, environmental and psychological conditions, the use of VR and risk, the culture of the maritime industry and social interactions and networks. The diversity of innovations shows how the complexity of the topic areas, the structure of the programme and the introduction of creative risk can support a group of designers in developing innovation in an unfamiliar area.

As well as exhibiting their work, a part of this showcase was a symposium, where each team of designers had roughly ten minutes in front of a judging panel to explain their projects and field questions. This panel would then decide which projects would win the awards of Best Innovation Prize and Best Risk Reduction Prize. The judging panel were: Dr Tim Slingsby, Director of Skills & Education, Lloyd's Register Foundation (panel chair); Prof Paul Anderson, Dean of the School of Design and Prof Ashley Hall (RCA); Dr Will Roberts, Senior Innovation Manager, Jeff Gould, Head of Innovation and Tim Robertson, Innovation Delivery Manager (RNLI); Chris Hoyle, Marine Pilot at Associated British Ports and Dr Vanessa Forbes, Lloyd's Register's health, safety, environment and sustainability Global Operations Manager.

The judges were impressed with the detailed understanding that all the design teams had developed within a relatively short time and the breadth of innovations that had developed from these insights. After some discussion, the judges decided that the winner of the Best Innovation Prize was Dynaweb, while the Best Risk Reduction Prize was awarded to CLS (Cross Lock System.) Both of the winning projects looked at making the pilot ladder safer either by redesigning the ladder itself through the use of cutting-edge manufacture and materials or in removing risk by introducing a secondary element that eliminates poor rigging and engenders communication between pilots on the cutter and a ship's crew on deck. This positive outcome of rigorous, valid and contextual innovations was achieved through a number of elements, including the hard work of the designers, the engagement, collaboration and committed participation of partner organisations and experts, an interdisciplinary mindset and a willingness to use creative risk in design thinking, design methods and design research through practice to develop well rounded projects that addressed the role of risk.

Innovation Prototypes

Cross Lock System (CLS)

Winner of Best Risk Reduction and Best Business Plan

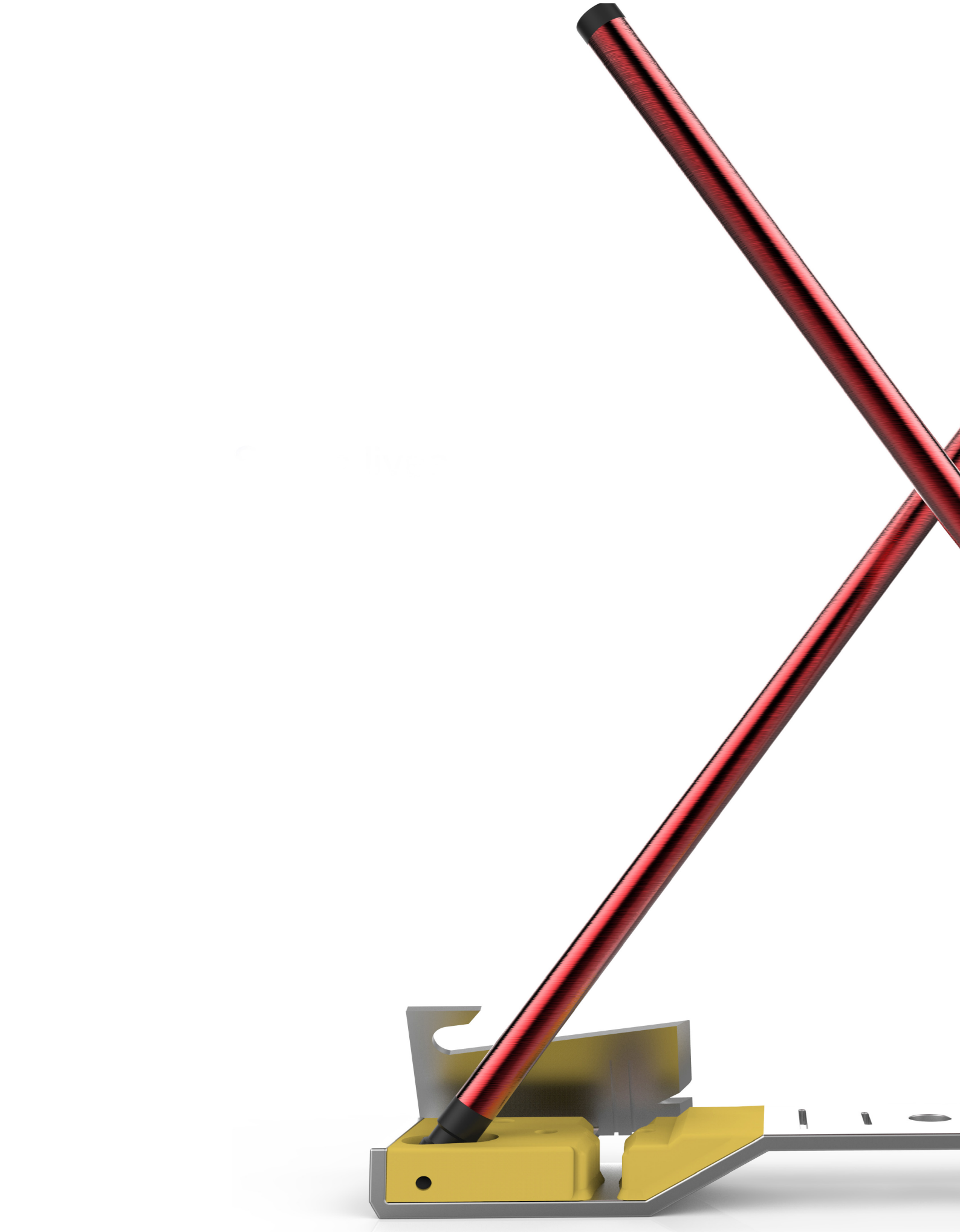
Team: Andrea Carrera Innovation Design Engineering, Madelaine Jane Dowd Information Experience Design, Mikhal Wertheim Aymes Global Design Innovation and Sarah Cronin Rodger Innovation Design Engineering.

The Cross Lock System is a human-centred approach to the safety of pilots at sea. The design is a foolproof pilot ladder rigging mechanism that minimises human error and takes into account language and communication barriers on-board ships at sea. Research has shown that human error in pilot ladder rigging is one of the leading causes of pilot injury or death. The secure fixing of existing pilot ladders within the CLS device is communicated visually when the stanchions are in their correct position. However, when the stanchions are crossed, the pilot is able to see that the ladder has not been rigged yet, or otherwise is not safe to climb. This allows the pilot to assess the situation and avoid injury or death.

The CLS has been designed to work in only one way and has strategic points of failure incorporated into it - any misuse or lack of maintenance will render the device inoperable before the pilot ladder is inserted. Removing human error also creates a positive psychological interaction between the crew on-board and those off the ship, fostering trust and respect for the user and provider.

The CLS has been designed to be easy to use, cost effective and economically feasible to a wide range of ship owners and can be fitted to most vessels within an hour while at berth. The product aims to seek certification as the standardised method of pilot ladder rigging, with visual identifiers displayed both digitally in shipping's Automatic Identification System (AIS) and physically by markings on the ship. Uptake on this device could be incentivised by providing preference in ports, reduced premiums on ownership or other benefits. The successful implementation of the CLS device will no doubt mark new territory in an effort to make one of the most dangerous jobs in the world safer for those that take up the challenge.

CLS (© Andrea Carrera, Madelaine Jane Dowd, Mikhail Wertheim Aymés, Sarah Cronin Rodger)



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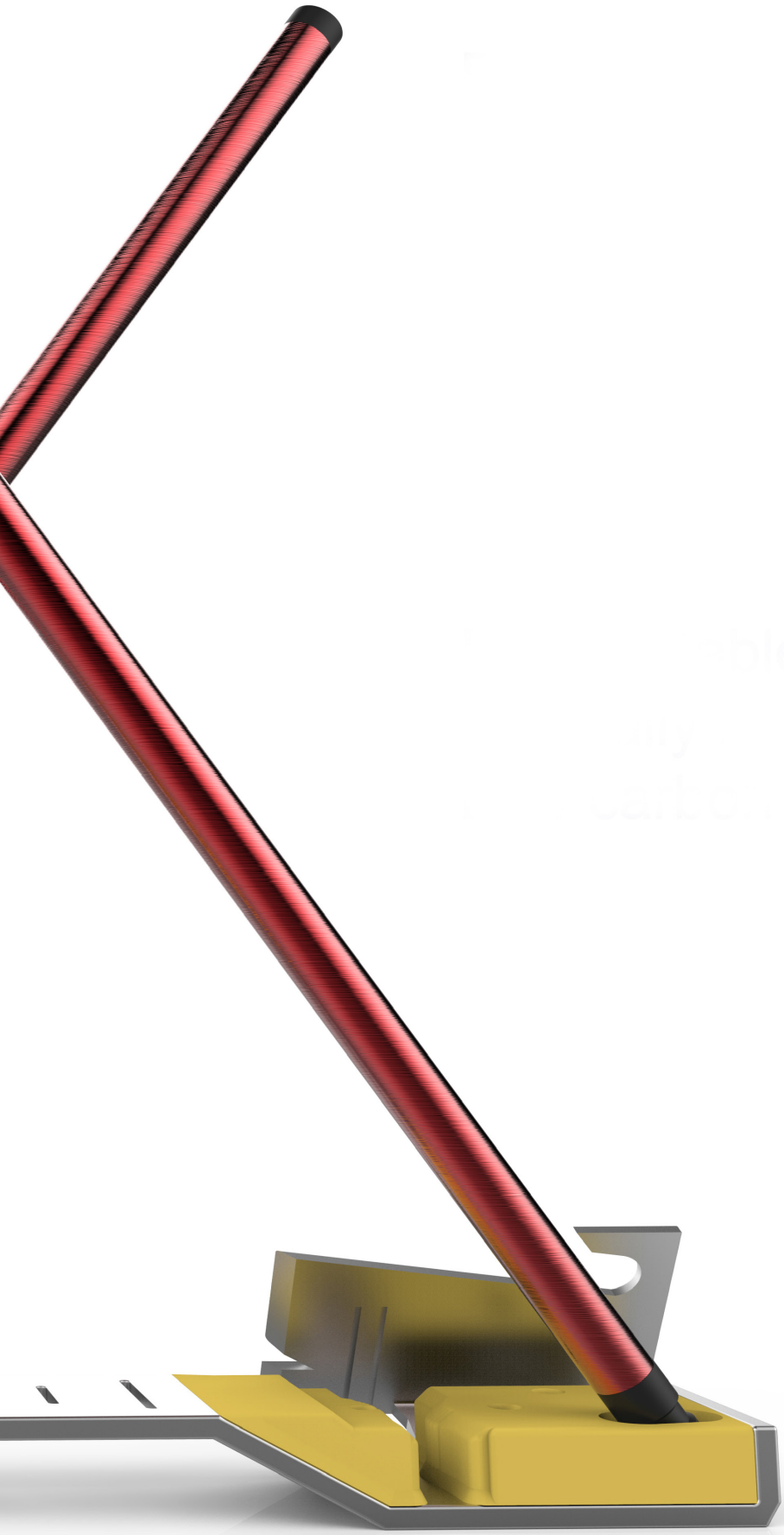
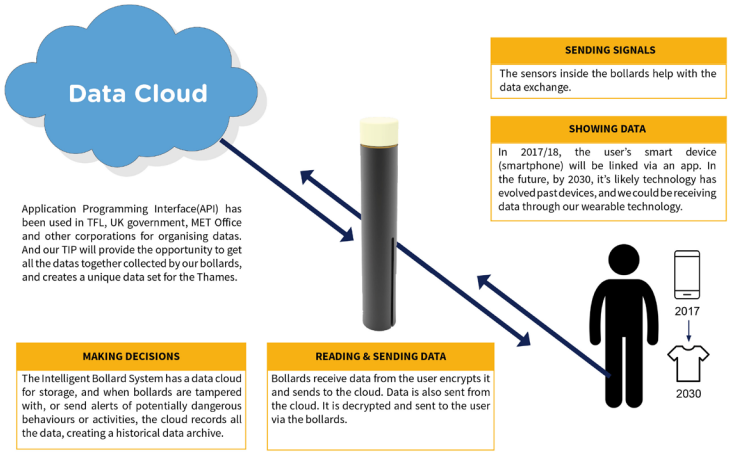
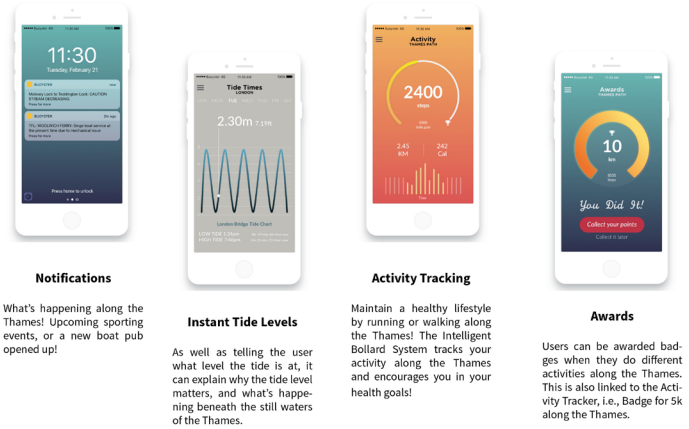






Buoyster data for public and institutional use (© Aliza Spicehandler, Niki Goransson, Yujun Liu, Ching Man Lam)

Bouyster

Team: Jason Liu Architecture, Keri Lam Design Product, Niki Goransson Innovation Design Engineering, Lizzie Spicehandler History of Design

Buoyster is an integrated system combining travel, security and public awareness solutions. The name Buoyster is a play on the word buoy and the Oyster travel card, and inspired by the saying "the world is your oyster," which for us means that everyone should be able to travel without barriers. We want to encourage use of and travel on the river Thames by using an integrated system with safety alerts, digital interaction, data analysis and information displays. This does not only act as a physical street appliance, but also functions as a smart device that reacts to people. The bollards are distributed along the riverside and house the electronic equipment that builds our system. Without establishing a solid barrier, the collection of our bollards will still allow people to enjoy the river as much as they want to. Proximity and light sensors will elevate the bollards to the next level, which will be adapting themselves to changes in the nearby environment and alert people when danger is occurring through the art of light.

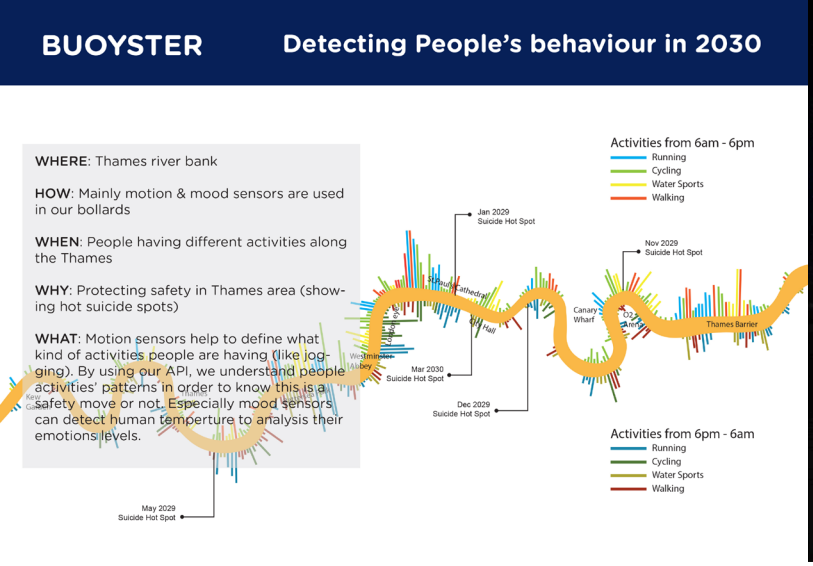
We are also introducing the Buoyster Cloud: a data collection and analysis system on top of the bollards. Information will be collected from environments and individuals and sent to different interfaces on a platform that is beneficial to lifeguards, police, transport authorities and the individuals themselves. In the future the bollards will also be able to display information to the public. We deeply believe that the Buoyster system will be the core player for safety along the Thames by 2030.

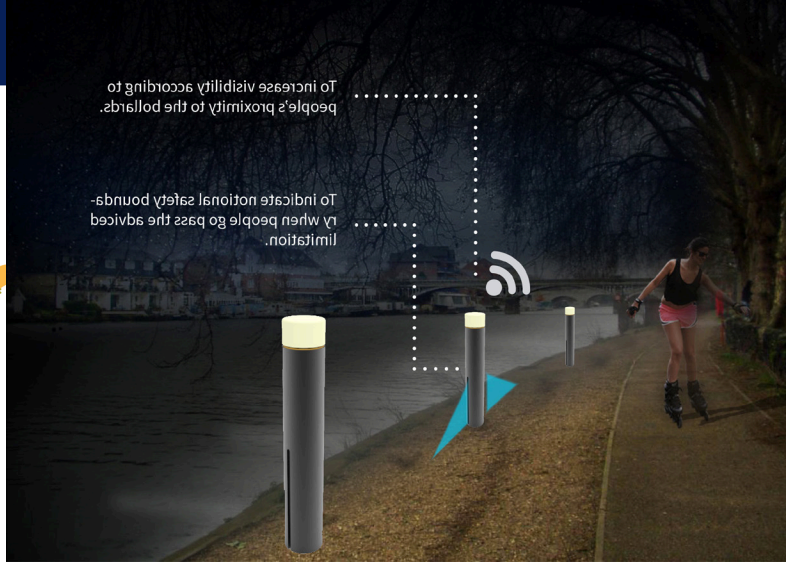
Expressive Ladder

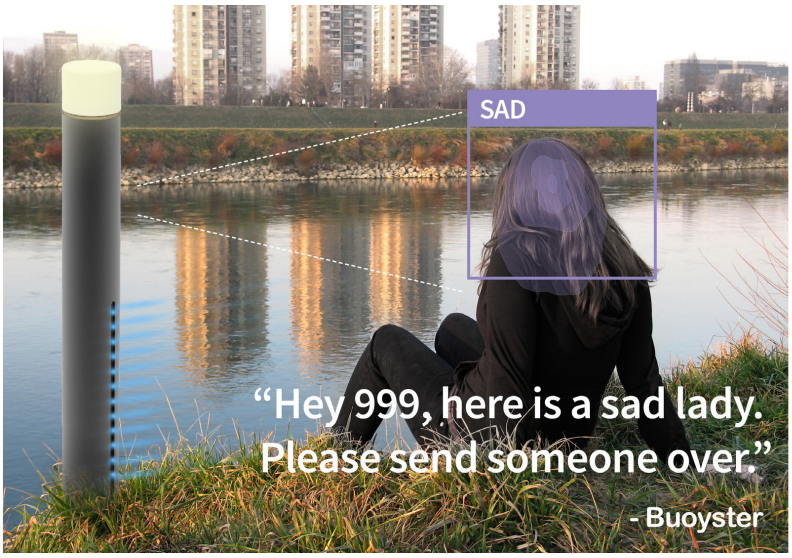
Team: Rara Larasati Innovation Design Engineering, Alice Miksova Innovation Design Engineering, Elliot Rogosin Architecture, Marcos Soares

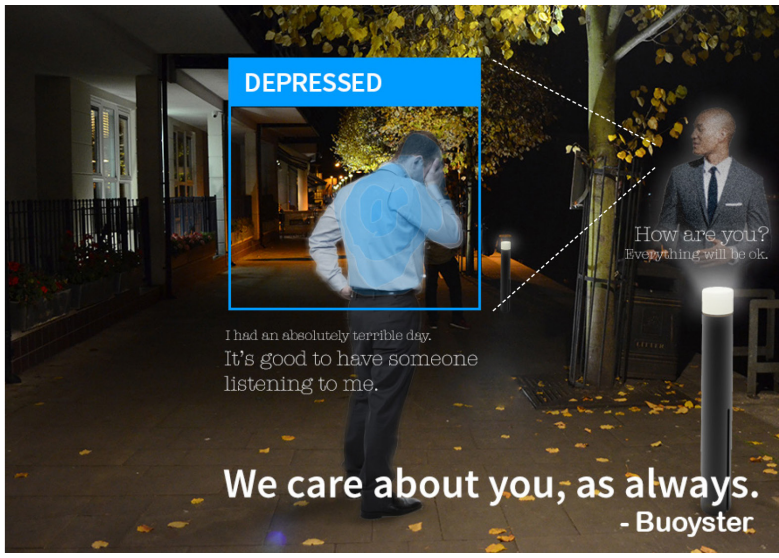
A pilot ladder ensuring increased safety and trust via visual cues, the Expressive Ladder aims to demonstrate the current condition of a ship's ladder in a positive manner and ensure the safety of the pilot. As a consequence, the Expressive Ladder provides gradual learning and a trust building system for the people in the pilot cutter and for the ship's crew through the use of positive visual cues. After a thorough analysis of the current ladder the group focused on improving its form, functions and materials. The new ladder engages everyone involved in an improved communication method, enables higher levels of mutual trust and brings new practical features for the pilot. The Expressive Ladder will contain the traditional feel of a pilot's ladder - moreover, it will introduce powerful visual cues able to indicate the ladder's condition and soundness.

We are introducing a practical and feasible solution of implementing incremental changes over a long period of time to the current methods used on pilot boats. The strategy encompassing the project is separated into three time periods that constitute "the horizons of implementability," which are the time frames responsible for introducing incremental changes to the ladder. These changes begin with features on the ladder itself and progress into a novel system promoting pilot safety on a

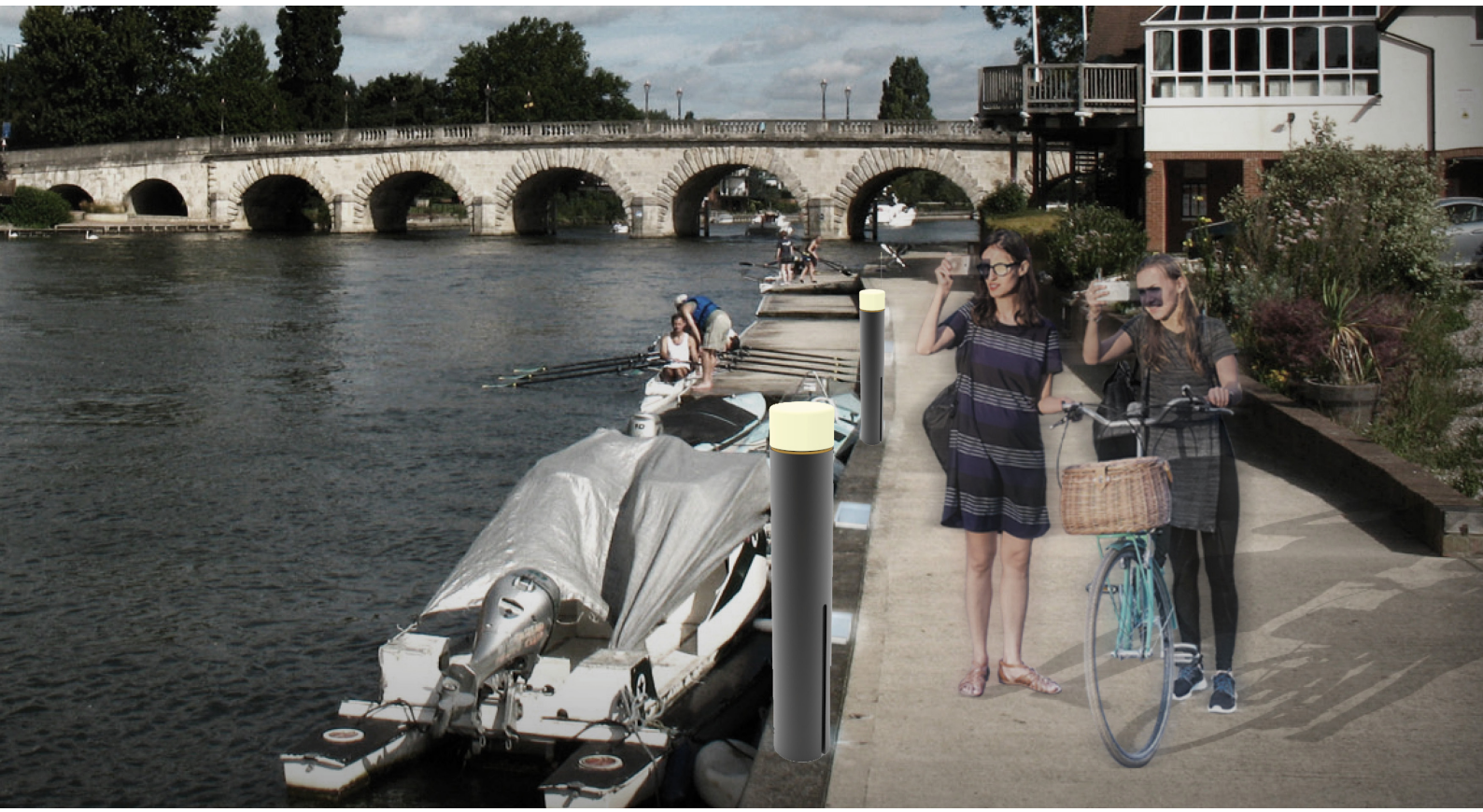




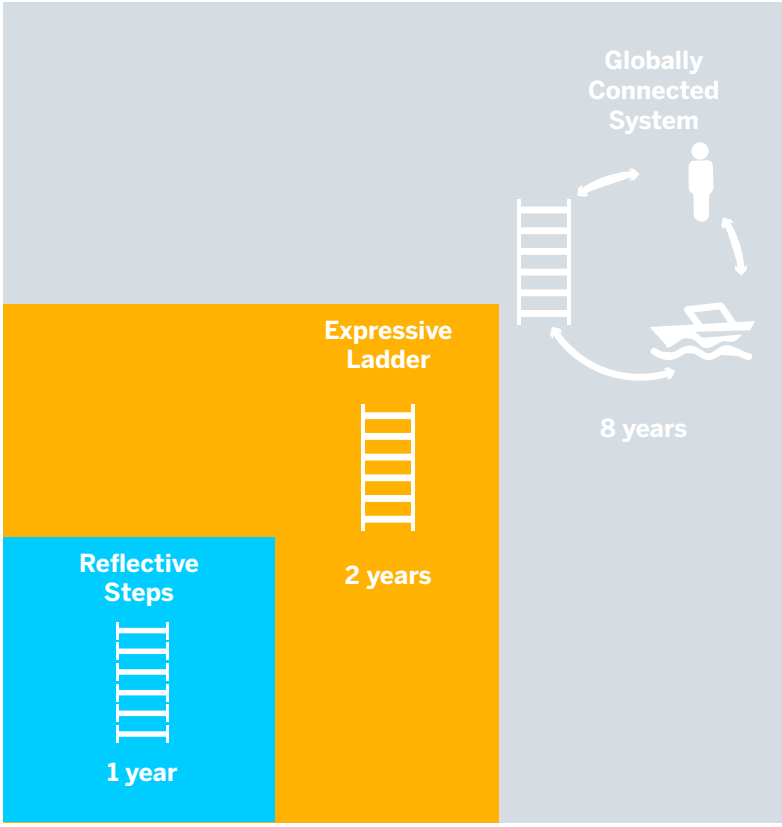




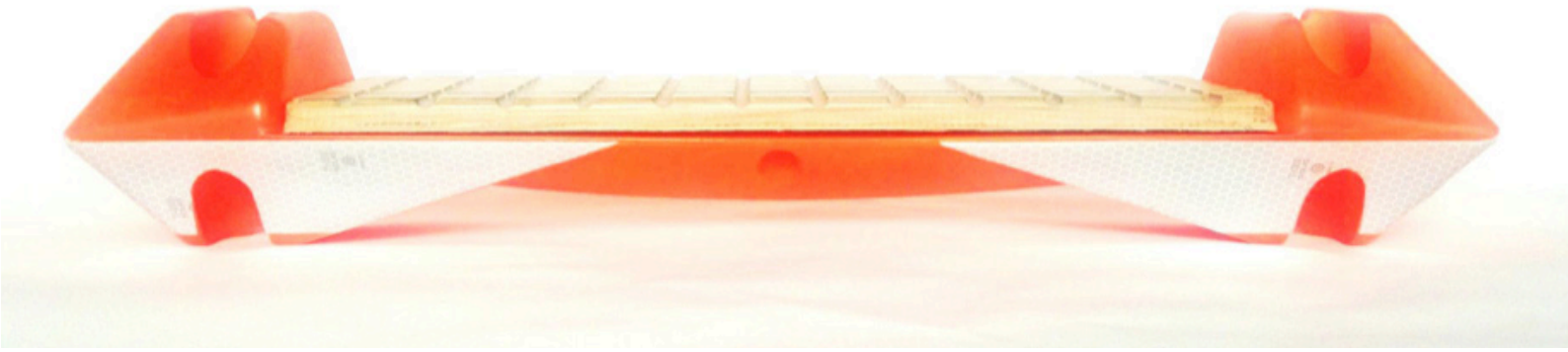
Bouyster detects people's behaviour to prevent suicides and accidental falls (© Aliza Spicehandler, Niki Goransson, Yujun Liu, Ching Man Lam)



global level. These horizons are linked by taxonomy of communication, with the aim of introducing better functional elements over time that ensure the safety of the pilot during a ship to ship transfer. The horizons of implementability also focus on the notion that different locations function within different time frames, so these horizons act as a long term plan and global solution to introduce the improvements for the entire fleet of pilot boats and ships endorsed by the Lloyd's Register Foundation.



Expressive Ladder.strategic approach.
(© Alice Miksova , Elliot Rogosin , Rara Larasati, Marcos Soares)



Expressive Ladder. Prototype of the step (top) and redesigned ladder with reflective stickers (bottom) (© Alice Miksova , Elliot Rogosin , Rara Larasati, Marcos Soares)

Expressive Ladder. Prototype casting process (© Alice Miksova , Elliot Rogosin , Rara Larasati, Marcos Soares)

Elly

Team: Dongyuan Li Innovation Design Engineering (2018), Xiaoyi Hu Service Design (2018), Yang Gao Innovation Design Engineering (2018), Yikun Wang Innovation Design Engineering (2018)

Elly is a life-saver in water. It is fast, powerful and stable, helping drowning people.

Ellys are stationed regularly along the Thames, monitoring the river from the banks. Ellys are distributed along the shore, attached under bridges, on the embankments and on the side of boats where they charge themselves automatically using tidal energy. Their detection range overlaps, leaving no space on the water unmonitored.

When someone falls into the river, the closest Elly detects it immediately using a DKL Lifeguard™, a passive electronic sensor that can detect a human heartbeat.

Elly then swims to the person straightaway and sends a message to the lifeboat station. With its strong motor and compact body, Elly reaches the drowning person in less than 2 minutes. Once with them, Elly automatically pumps itself up and gives out heat to, so the person can hold onto it to float in the water and keep warm in the freezing water. As time goes by more and more Ellys arrive, helping with floating and heating. They also glow, so rescue crews can spot the drowning person easily and save them quickly.

As well as the primary, life-saving function we also see possibilities for Elly to help with water quality monitoring, underwater ecology protection, and even to be used as part of shows and spectacles on the river.

Elly prototype (© Dongyuan Li, Hu Xiaoyi, Yang Gao, Yikun Wang)

Dynaweb

Winner of Best Innovation and Best Business Plan

Team: Nick Hooton Innovation Design Engineering, Irene Chiu Vehicle Design, Chih-Hsing Huang Design Product, Chia Cheng, Kung Design Product

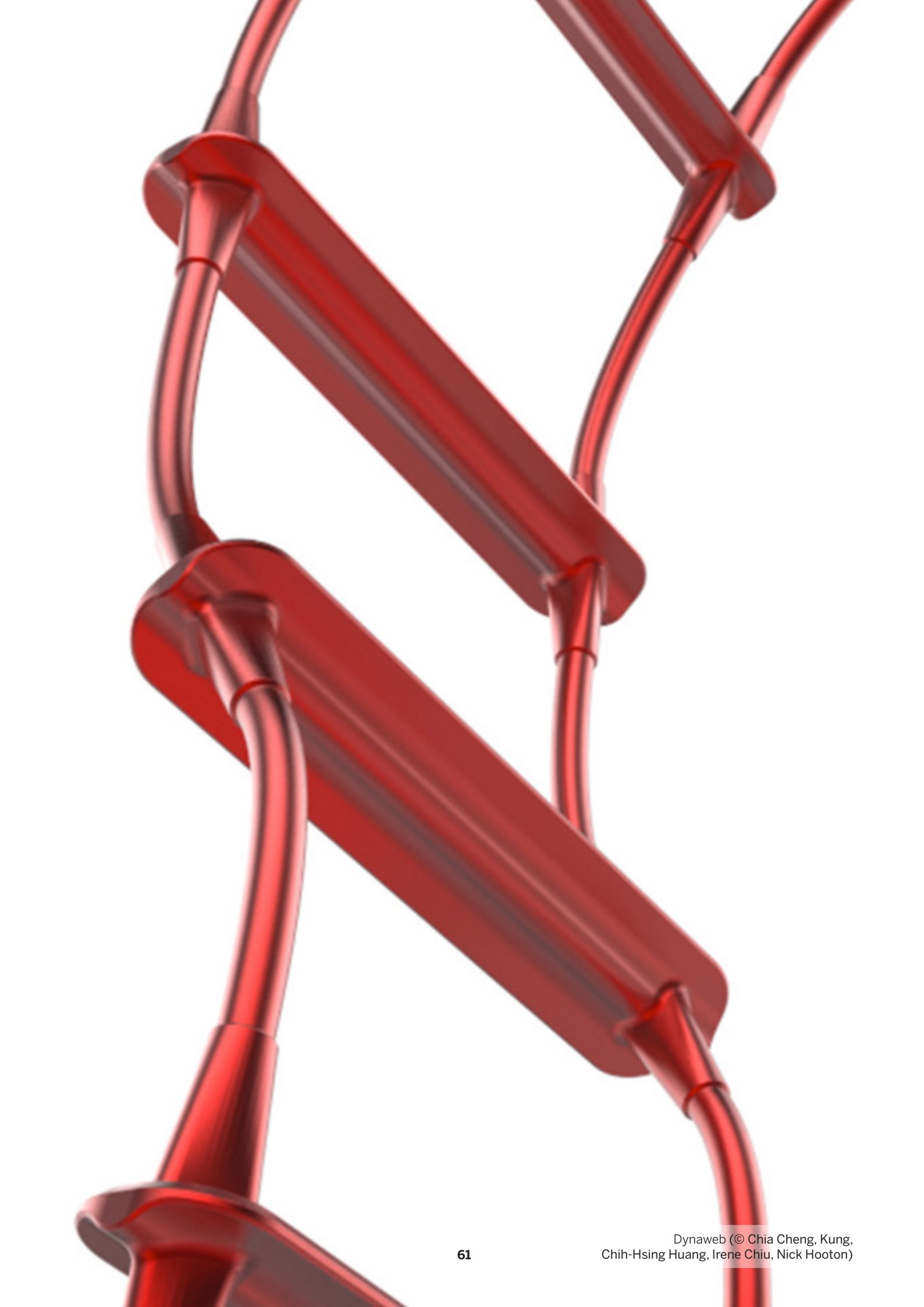
Embark safer. Embark with control.

Dynaweb harnesses modern manufacturing techniques to achieve precise control of material flexibility at every point in the pilot ladder. This innovation provides the unique opportunity for determining the ladder's dynamic behaviour and using ultralightweight materials.

Vertical flexibility of the ladder is crucial for safe pilot transfers in turbulent conditions. However excess ladder flexibility makes it difficult to mount and climb. Dynaweb limits lateral swing and twist while maintaining vertical flexibility.

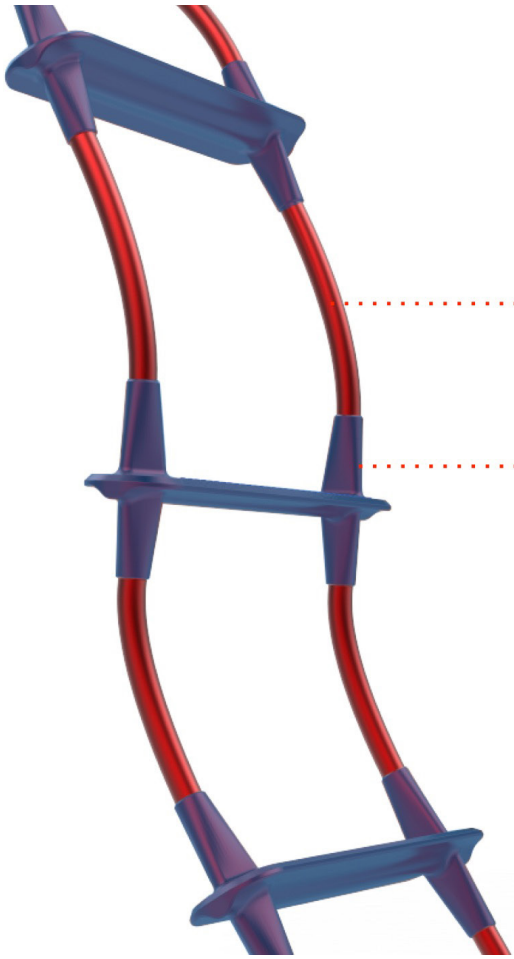
Since the ladder's stability is no longer derived from its weight, lightweight materials can be used. Traditional manila rope and wooden steps have been updated to a Dyneema fibre reinforced rubber composite. The long lengths of synthetic fibres gives continuous strength throughout the ladder. The one-piece ladder removes the need for mechanical connections which act as points of weakness, especially in extreme and corrosive environments. The result is a ladder which is three times lighter and ten times stronger.

Looking to the next generation of Dynaweb, additive manufacturing technology will enable greater customisation, from tailoring step sizes to applying generative design methods that help optimise weight and strength.



Dynaweb (© Chia Cheng, Kung, Chih-Hsing Huang, Irene Chiu, Nick Hooton)

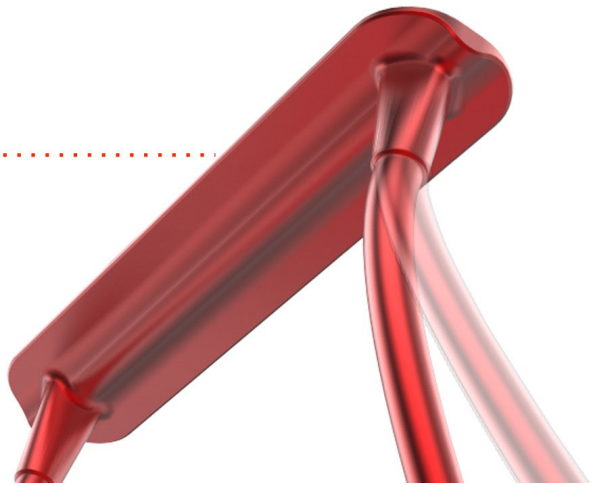
Ergonomics



Flexible

Rigid

Lateral rigidity

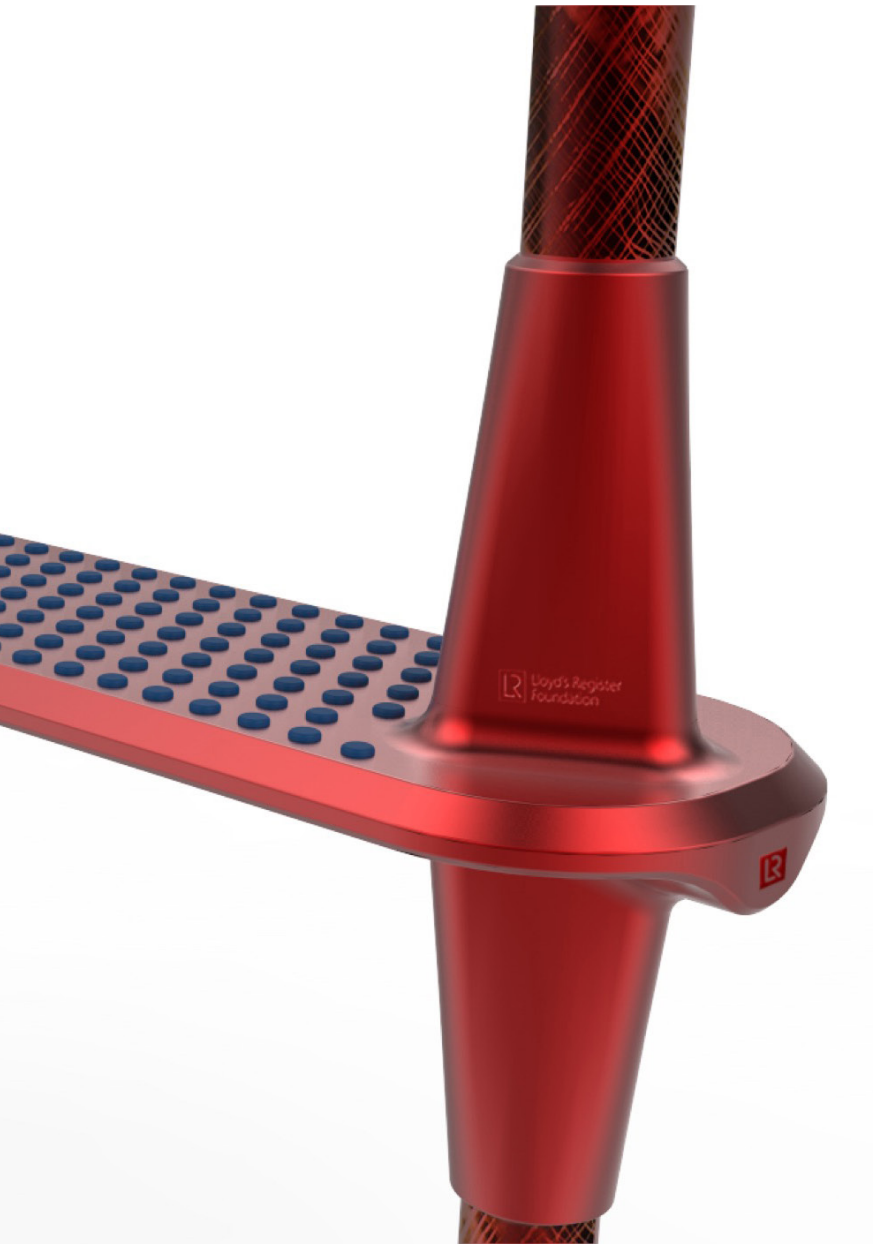


Dynaweb, steps of innovation 2018-2030 and 2030 generative stage (© Chia Cheng, Kung, Chih-Hsing Huang, Irene Chiu, Nick Hooton)

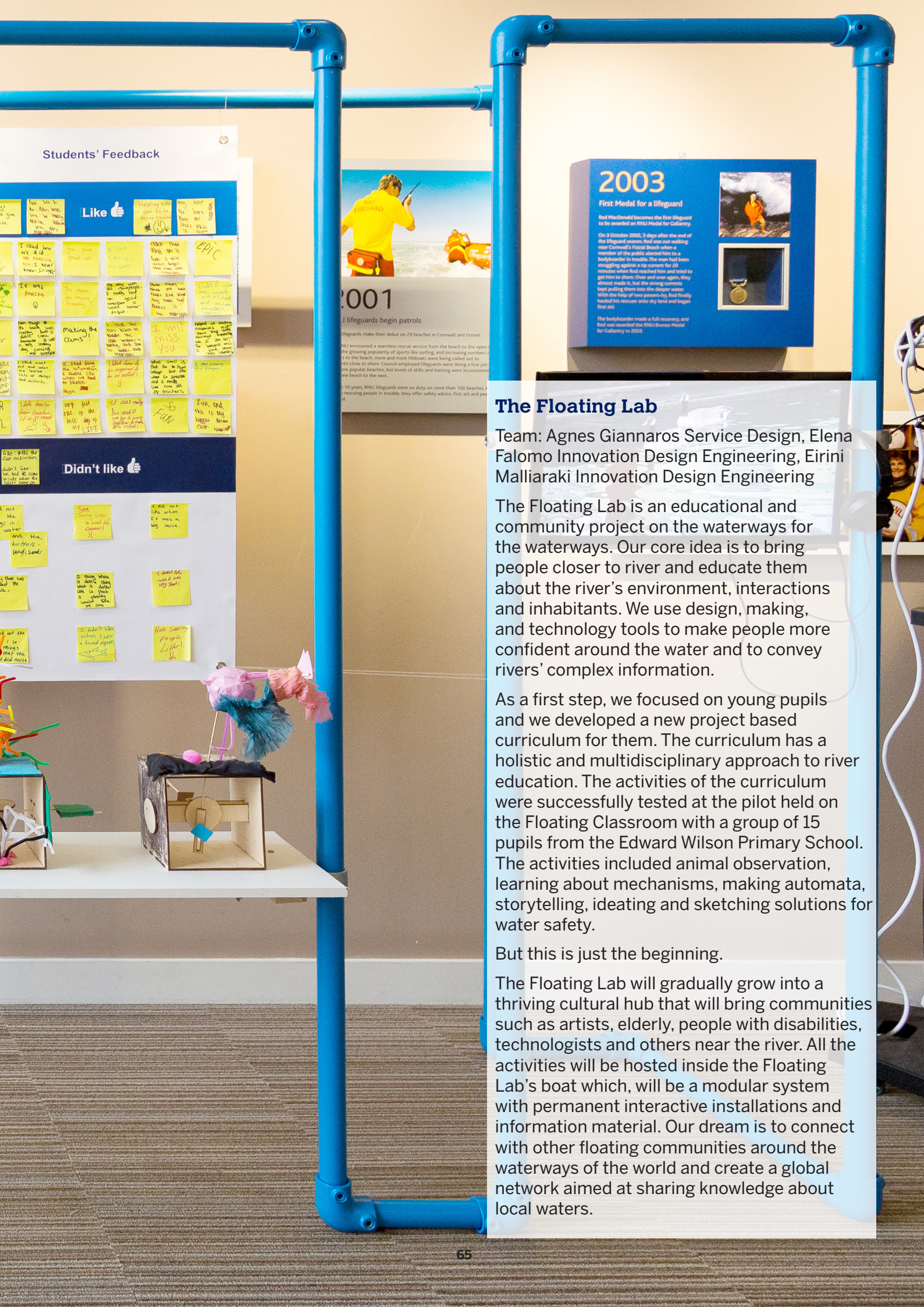
DYNAWEB
2030

Generative design

- Shape and structure optimization
- Optimizing for strength, weight, flexibility
- Only possible with additive manufacturing



The automata produced during the safety workshop for primary school children (© RNLI)



The Floating Lab

Team: Agnes Giannaros Service Design, Elena Falomo Innovation Design Engineering, Eirini Malliaraki Innovation Design Engineering

The Floating Lab is an educational and community project on the waterways for the waterways. Our core idea is to bring people closer to river and educate them about the river's environment, interactions and inhabitants. We use design, making, and technology tools to make people more confident around the water and to convey rivers' complex information.

As a first step, we focused on young pupils and we developed a new project based curriculum for them. The curriculum has a holistic and multidisciplinary approach to river education. The activities of the curriculum were successfully tested at the pilot held on the Floating Classroom with a group of 15 pupils from the Edward Wilson Primary School. The activities included animal observation, learning about mechanisms, making automata, storytelling, ideating and sketching solutions for water safety.

But this is just the beginning.

The Floating Lab will gradually grow into a thriving cultural hub that will bring communities such as artists, elderly, people with disabilities, technologists and others near the river. All the activities will be hosted inside the Floating Lab's boat which, will be a modular system with permanent interactive installations and information material. Our dream is to connect with other floating communities around the waterways of the world and create a global network aimed at sharing knowledge about local waters.

Sea Pilot's Assistant (SPA)

Team: Yu Li Design Product, Marcus Comaschi Innovation Design Engineering, Jen-Hsien Chiu Innovation Design Engineering, Jingyi Wu Innovation Design Engineering

SPA consists of a simple, robust and modular pilot ladder and smartphone application to ensure a safe pilot transfer process.

We have been working with current British sea pilots, the RNLI and the Port of London Authority to design a safer, more cost-effective and robust system for pilot transfers worldwide. Through extensive research, interviews and prototyping we set our aim of designing to ensure all pilots globally use a safe ladder in every port around the world. Beyond this, we wanted to ensure the ladders are maintained regularly and ships crews always follow rigging procedures. We wanted to achieve this without the need to redesign the ships architecture, which would be complex, costly and impractical.

We have designed a simple and easy to use modular ladder encompassing the classic pilot's ladder design where parts can be replaced quickly, easily and in a more cost-effective way for the ship. The manufacturing and replacement of these parts would be managed in a centralised SPA HQ, where old modules are also collected, reviewed and used for continual development of the ladders design.

The SPA system also features a smartphone app, which can be downloaded by all pilots and ships across the globe, and is our solution to breaking down language barriers and ensuring correct ladder rigging. The SPA app allows a pilot to rate a ship's ladder, communicate with other pilots and even help manage their work through a range of tools.

We think our solution is one that can rapidly scale throughout the world. It is very cost-effective for shipping companies, as there would be no need to replace whole ladders. Smartphone applications also have their own unique benefits and the SPA app can quickly be put to use with small investment.

This is a journey, a journey that we would like to begin now to reduce the number of pilot transfer accidents to zero and help save lives at sea.

SPA modular ladder components
(© Jingyi Wu, Marcus Comaschi, Yu Li, Jen Hsien Chiu)

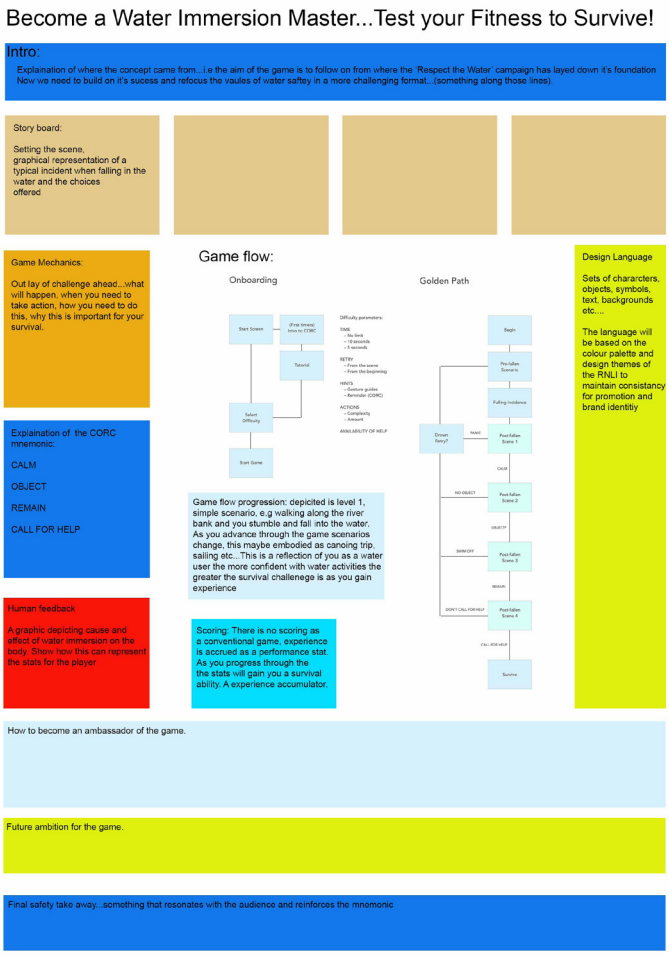
Calm Object Remain Call for help (CORC)

Team: Simon Cundall Innovation Design Engineering, Linh Pham Visual Communication

The CORC initiative is a online and mobile interactive game concept that helps river users to understand what happens when an individual accidently falls into the river. CORC stands for Calm, Object, Remain, Call for Help - this simple saying is a mnemonic, easily remembered and much like the first aid 'ABC' emergency memory aid. The phrase is the unpinning emphasis of the game: the aim is to keep Calm, find a suitable Object to keep you afloat, Remain in your position and Call for Help. The game is designed to be fun and progressive, presenting the user with a series of visual scenarios by the riverside in differing circumstances. Decisions are presented to the participant and outcomes are determined by their ability to read the situation, make quick and informed choices and act accordingly to prevent the incident escalating.

How does it work? This is a multi-level experience where successful achievement is based on a number of outcomes. Firstly, it's a game of learning whereby the CORC mnemonic is reinforced continually. Secondly, the mechanics of play are based on physical actions; mimicking as closely as possible life saving technique postures, motions and signals required to keep alive. Finally, much like life, there is a degree of luck within the game result, meaning that it is not always possible to win/ survive. CORC is also different to current game scoring structures - with CORC your score will be based on experiences based on your progress through the stages of play,

A set of statistics held within the game will provide an individual benchmark standard of 'Your Fitness to Survive.



CORC, architecture of the video game (© Simon Cundall, Linh Pham)

Findings & Conclusions

The Safety Grand Challenge ran from August 2016 to February 2017 delivering eight novel design led innovations focussed on reducing risk and saving lives on water. The collaborative nature of the project was supported by research methods that engaged with expert users, enabling open dialogue and continued involvement of industrial experts and the design teams. This meant that the designers were provided with an understanding of the granular practical and cultural aspects that impacted on the research areas alongside the broader systemic context of the topic.

Safe Ship Transfers and River Thames 2030 were developed through common design methodologies, which allowed for flexibility to deal with the complexity that each topic required. Safe Ship Boarding and Thames Safest River 2030 are both highly complex risk areas, involving a range of stakeholders with different views engaging with an incomplete and ever changing situation that can never be truly solved, only improved. In the past both of these topics have been investigated by researchers from an engineering and scientific perspective, with a number of solutions to mitigate the impacts of these issues. The main commonality between these two topics, however, is in addressing problems that would expose the respective communities to dangerous situations and attempting to minimise this risk and raise public awareness towards risk through different forms of engagement.

The grand challenge research project delivered academic value and design impact in eight months through three key elements: Interdisciplinarity, a blended structure of Action Research and Participatory Design and by embracing the role of Creative Risk in mitigating risk to life. This research model created a social platform for the stakeholders, expert users, RCA team and designers to collaborate and work towards a shared design research goal. This led to rigorous and innovative design proposals that demonstrated the value of design thinking in what was traditionally a non-design context and addressed design, risk and safety - the key aspects of the Safety Grand Challenge.

Interdisciplinarity & Design Thinking

Interdisciplinarity was an integral element of this project in working together and delivering successful outcomes, from the development of relationships between the key organisations involved, the methods and approaches of exploring the issues being tackled, to the structure of the project and the backgrounds of the designers involved. Since the beginning of the project and the initial meetings with partners and stakeholders, we recognised that the Safety Grand Challenge framework would rely on collaboration between experts, academics and designers. This was similar to Ovink's Rebuild by Design community, which focuses on developing city and community resilience by bringing experts and people from around the world together to challenge and tackle global problems, like flooding and climate change (Ovink, 2016). In a similar manner, we embraced the positive aspects of diversity in skills and backgrounds to enrich the territory that we used to engage with both topics.

Along with the Lloyd's Register Foundation, there was a range of stakeholders, partners and experts involved with various opinions and understandings of the Challenges.

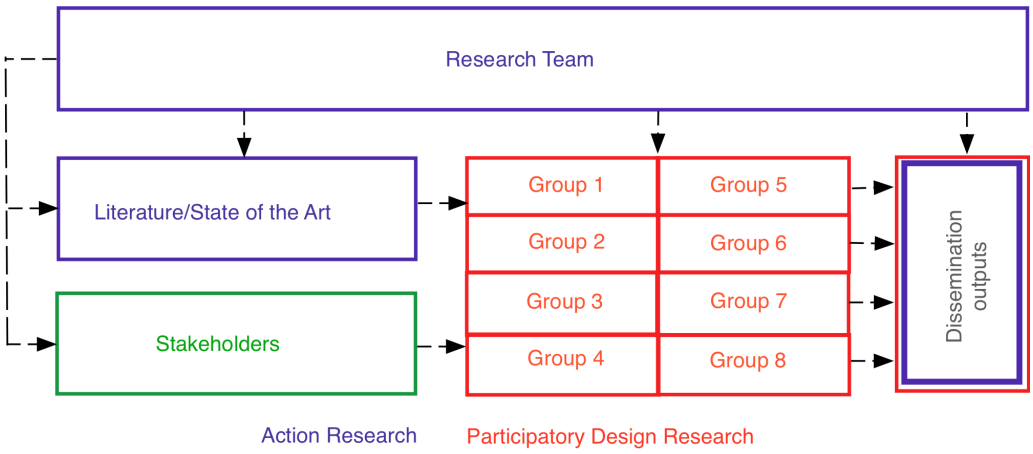
"Design for Safety at Sea" postcard and symposium schedule (© Laura Ferrarello)

As collaboration is a tested approach that is particularly used in interdisciplinary contexts, the external partners' participation was not merely considered as providing an additional viewpoint, but as a vital component to guide the whole project along all the different phases of the Challenge. To integrate this element we scheduled regular presentations that would bring all the parties involved into the same space. This mechanism enabled a continually evolving dialogue between the parties and meant that the final prototypes would represent a tangible outcome representative of this collaboration. Through these expert contributions, each partner actively engaged in the research, enriching the shared body of knowledge on design and safety. This interdisciplinary, collaborative approach also applied to our relationship with external institutions, ensuring that all participants felt that they 'owned' the project and meaning that they were actors in the Challenge, rather than mere observers.

Another consideration concerning interdisciplinarity is the interaction of the 32 designers in the project. Diversity as a concept has been iterated throughout the project and the selection of the designers involved was an important element of this. The eight groups of postgraduate designers who took part in the Safety Grand Challenge were enrolled in a variety of Masters degrees that the RCA offers. As well as the School of Design, representatives of the School of Communication, School of Fine Art, School of Humanities and School of Architecture were involved in the project. This project was an opportunity for them to work together and engage with other disciplines, methods, and understandings, both in their design teams and with the project partners. This collaboration with unfamiliar people and practices provided an important learning experience (Hall & Childs, 2009) that will positively impact upon the development of their future professional career.

A key element of the RCA and Lloyd's Register Foundation collaboration was the exploration of the role of design thinking in a field that is typically approached from a narrower engineering or science-based position. Both institutions were interested in exploring how this design led approach could address the complexity of safety on the water and from this shared understanding work towards engendering new attitudes and a new culture towards risk and safety. Business models are changing to incorporate 'design thinking' in an effort to encourage creative approaches to problems (Kimbell, 2009), understand human factors and encourage risk (Kolko, 2015), so by understanding danger through the lens of design, there was an opportunity to develop a sustainable, human infrastructure that collectively understands risk through the knowledge of the methods that ameliorate danger.

Through this new understanding, we aimed to move beyond current practices towards safety, where a group of experts define the risk scenario procedures, strategic planning and risk assessments are structured on the basis of cascade scenarios and the user's role is to follow those procedures with a limited form of engagement and understanding. Our intention was to design a new culture of safety that works on a collaborative, bottom-up basis and facilitates engagement of varied parties with



Combined Action Research and Participatory Design model, (© Ashley Hall)

different skills, expertise and knowledge.

Action Research & Participatory Design

This interdisciplinarity and the necessity of involving partner organisations added another layer of complexity to an already complex set of design safety scenarios. The role of the RCA team in developing an understanding of the key issues and good relations with external stakeholders was complicated by the fact that they had to step back and allow the designers to engage with the Grand Challenge. We had to consider how to structure interaction between the designers, the RCA design research team and all external stakeholders throughout the course of the project.

As previously, our solution to this was to develop an approach based on a combination of action research and participatory design research and create an infrastructure that could facilitate and encourage dialogue. The student groups used a participatory design research-practice model where they combined industrial strategic expertise from the Lloyd's Register Foundation team with applied industrial experience from the RNLI, MPA, IMPA, PLA and CHIRP. The academic design research team mediated exchanges between action research and participatory design research in a hybrid research method, as shown above (Foth & Axup, 2006).

The collaborative social platform that was built around the project through design research offered everyone a space to work and engage with the project and each other. The Safety Grand Challenge could be described as a research platform where academic and external institutions worked together towards a common design research ambition.

This common ground between academia and industry positioned design as a social platform to enable people of different backgrounds to participate in risk reduction by sharing the knowledge that they had gained from practice and theory. To facilitate this model the researcher-tutors had to directly observe and collaborate with the organisations involved through field trips, teaching and building relationships with other partners and interested parties. This approach encouraged engagement; an aspect of the project that the Lloyd's Register Foundation aimed to initiate in promoting a design led project tackling a Safety Grand Challenge.

The combined Action Research and Participatory Design research practice methods were successful in achieving a variety of results; each team and participant looked at design and safety from a different viewpoint and accordingly produced range of quite different prototypes. Combining the relevant elements at the correct point of the project played an important role in it is success, in particular in the context of the research goal of understanding the relationship between design and safety. Through mixing seminars, workshops, field trips and the literature review, the designers were able to appreciate the complex nature of the risk scenarios, helping to give a clear picture of the elements that contribute to mitigating existing risk situations.

This hybrid research method was successful for the researcher-tutors in providing them with flexibility and feedback loops to guide the project and for the postgraduate designers,

Lloyd's Register Symposium (© Ashley Hall)


NEWTON
S-P-A

embedding key stakeholders throughout the project. This format enabled knowledge exchange by keeping every involved party engaged throughout the entire process and maintained a mutual understanding of progress. This had two benefits: it provided insights that were useful to creativity while also reducing outcome risks by including partners through every stage of the project. The researcher-tutors and design teams both had differing and overlapping methods requirement and the methodology combination proved to be successful in meeting the challenge.

The benefits of the engagement that this model facilitates can also be seen in the change of attitudes towards design as a discipline. At the first meeting at the Lloyd's Register Innovation Centre one industry expert expressed incredulity towards the idea of an 'art college' working on something they believed to work adequately, however by the end of the project they were deeply involved. This model managed to blur boundaries (Sennett, 2013) and brought a wide range of views on board to work with us and the team of designers.

Creative Risk

The minimisation of risk in industry and the role of design in the Safety Grand Challenge directed an important element of the project through our understanding of the subject areas and how to engage with them from a designerly position. As the aim of the Safety Grand Challenge could be said to be about minimising the exposure to risk of communities on and around water, it seemed appropriate to maximise the creative risk that the designers were exposed to. The combination of both aspects gave us the opportunity to shape creative risk, as an innovative form of practising risk procedures and culture that encouraged designers to be able to apply creative skills that would impact risk reduction and coherence in the final design innovation.

There were also different types of risk to consider in both topics of the Safety Grand Challenge. Project risk to ship's pilots consisted of a 'grandfathering' culture, lack of trust in equipment rigged by unknown people, the pressures of contemporary trade and industry, a 300 year old pilot ladder technology that has had little evolution, the technical challenges of extreme environmental, temperature and weather conditions and the complex interactions of behaviours and cultures in shipping. Thames Safest River 2030 had quite different project risks, such as engaging with complex future design risk, how to identify a design brief that could engage stakeholders and how to locate future scenarios and technologies. One of the key aspects of increasing creative risks was the project format of groups of designers working in teams that mixed disciplines and cultures. This cultural and disciplinary mix of people who hadn't worked together before increased the variety of the group, and combined with permission giving activities in the early stages of the project (Design Exorcisms, Rotating Tables) set the project stage, allowing the designers to think differently.

The following short case studies show the impact of this embedded creative risk on the designer's practice, thinking and the design innovations, which range from an app for ship's pilot boarding driven by social behavioural understandings, to an autonomous aquatic

drone swarm that supports people in the water until rescue teams arrive. Each of the projects increased creative risk by using abductive thinking (Lu & Liu, 2012) to project new future possibilities at different levels of realisation.

Sea Pilots Assistant (SPA) -Through evaluating the entire design risk scenario of ship boarding, the designers on this team realised that ship's pilots wanted confidence in the quality and rigging of the ladders they use. This came from the realisation that many incidents are a result of bad rigging and that pilots can only know how well a ladder is rigged once they have successfully climbed it. The designers were interested in the potential for affecting behavioural change by leveraging the relationship between the pilot and the ship's crew, playing on the dynamics of trust in relationships, incentivisation and confidence building. In this instance the designers re-imagined the ecosystem of ship to ship transfers and enabled new forms of communication by importing design communications from social media platforms supported by crowd sourced information.

The global smartphone app that they developed allows pilots to report confidence and doubt in the rigging of ladders in real time with pictures and film. In the current system pilots can report dangerous ladders on to the next port, however the feedback loop of improvements to rectify problems have been done and reported back is missing and standards and global adherence can be variable. SPA helps pilots by showing the pilot equipoment and rigging star rating history of the ship, allowing them to assess the level of risk involved and confidence in the crew and equipment before boarding.

This impacts on a global scale of developing a new culture of trust through a network of historical information, could be a distinct psychological benefit to pilots, especially in poor weather conditions. This design innovation provides a low investment, global solution that supports confidence building and where the elevated creative risk pays off in introducing a digital, social-media solution to safety at sea.

Elly - Future safety challenges on the river Thames needs fresh thinking and new risk reduction systems. In realising that human based rescue speeds were already largely maximised, this design team's insight involved considering an alternative autonomous system that would save more lives; particularly in the event of a mass casualty event which could swamp current resources.

The designers began by looking at examples from the animal kingdom and found an experimental system where the superior eyesight of pigeons was used to identify casualties at sea. This encouraged a search for metaphors from the marine world, with led to the group eventually choosing the metaphor of a jellyfish. This inspired the concept of an inflatable robotic aquatic creature that could be deployed from the banks of the river to save lives.

Elly is situated underneath bridges and on the river banks, gathering energy through solar and tidal means until needed. At this point it quickly jets across the water, providing floatation, warmth and light to the person at risk. Multiple Elly can also join together to form lifesaving mats if needed. While Elly does not provide all of the capabilities that a manned craft can, they act as an interim measure that can support

SPA app interface and modular ladder business strategy (© Jingyi Wu, Marcus Comaschi, Yu Li, Jen Hsien Chiu)

Centralised SPA HQ
- Continuous development of app and ladder modules
- Manages news & updates for ships and pilots

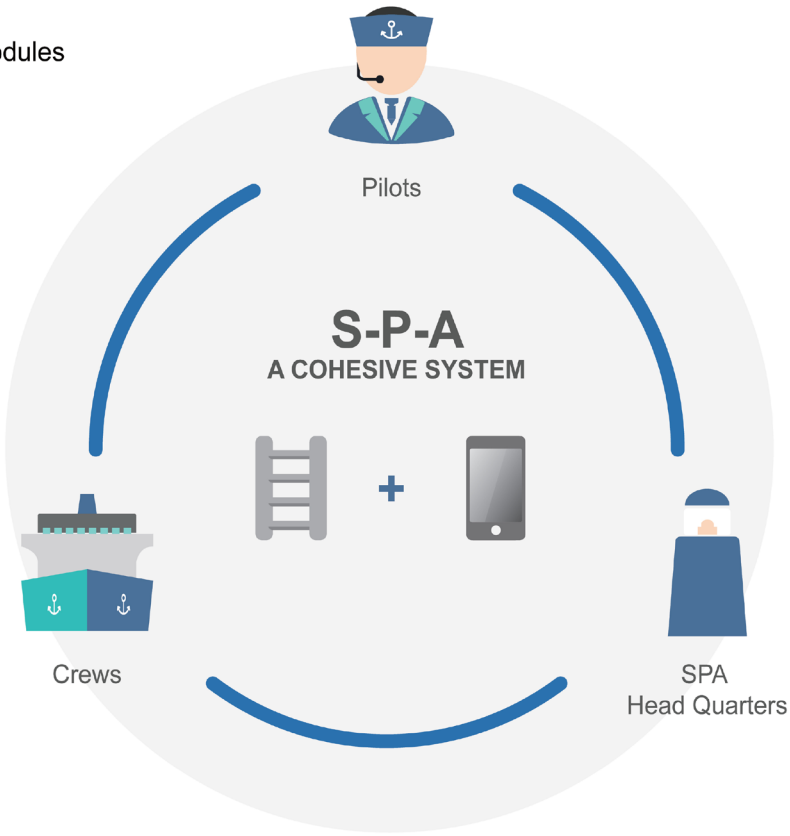
Standardised modular ladder parts
- For easy replacement
- Cost-effective

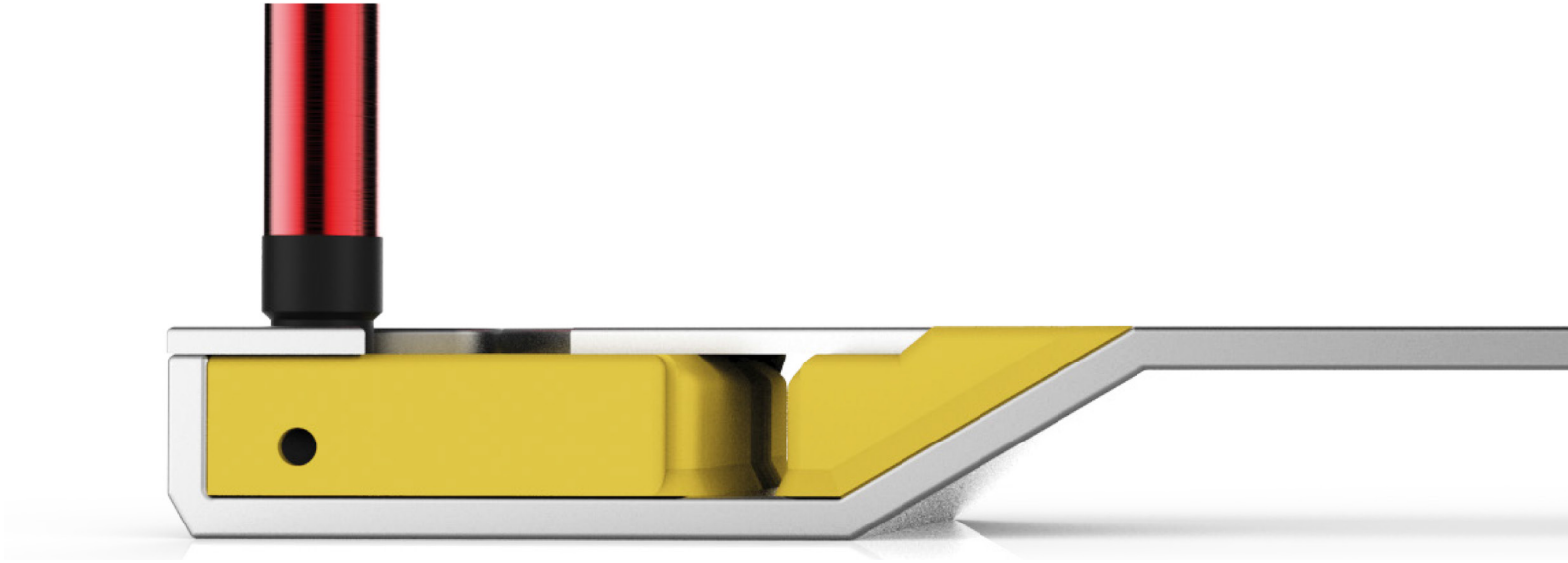
Maintenance
- Modularity makes maintenance easy

Stackable design
- Enables neat stowage of ladder

SPA App
- Informs and connects pilots
- Breaks language barrier
- Helps manage work

- Ability to report on events & ladder condition





CLS (© Andrea Carrera, Madelaine Jane Dowd, Mikhail Wertheim Aymés, Sarah Cronin Rodger)

help arrives.

One insight is that jellyfish tend to have negative associations for people in the water. The designers identified this creative design risk, but felt that this metaphor was useful to them in the design phase. However, they agreed to propose and market the further developed innovation under a different name.

These examples show the different ways that creative risk that tackles some of the complex risks to life in ship-to-ship transfers and the future river Thames has been encouraged through this Safety Grand Challenge.

SPA adapted a concept from a social media platform of shared experiences and the crowd sourcing of expert opinions to give a numerical value based on quality aggregated feedback. This could provide a reasonable indication of confidence to help increase trust between the pilot and the ship's crew over time. The creative risk involved in this innovation is in shifting a concept from an initial area to a new one; although it is likely that many pilots will have encountered something similar before online via social media.

Elly used increased creative risk to reduce risk to life by developing the concept of an advanced autonomous robotic system based on the metaphor of a sea creature - the jellyfish. As mentioned earlier, this choice may have negative associations for people in the water, which illustrates that when increasing creative risk to encourage a positive impact, the negative implications need consideration. As the technological aspects are in development it may take some time to develop a fully working prototype. However, the benefit of projects like this is in signposting developments for future lifesaving innovations and inspiring new creative opportunities. In addition, this project moves beyond human led life saving assumptions and recognises that autonomous systems will very likely be trusted for early rescue and treatment.

Conclusion

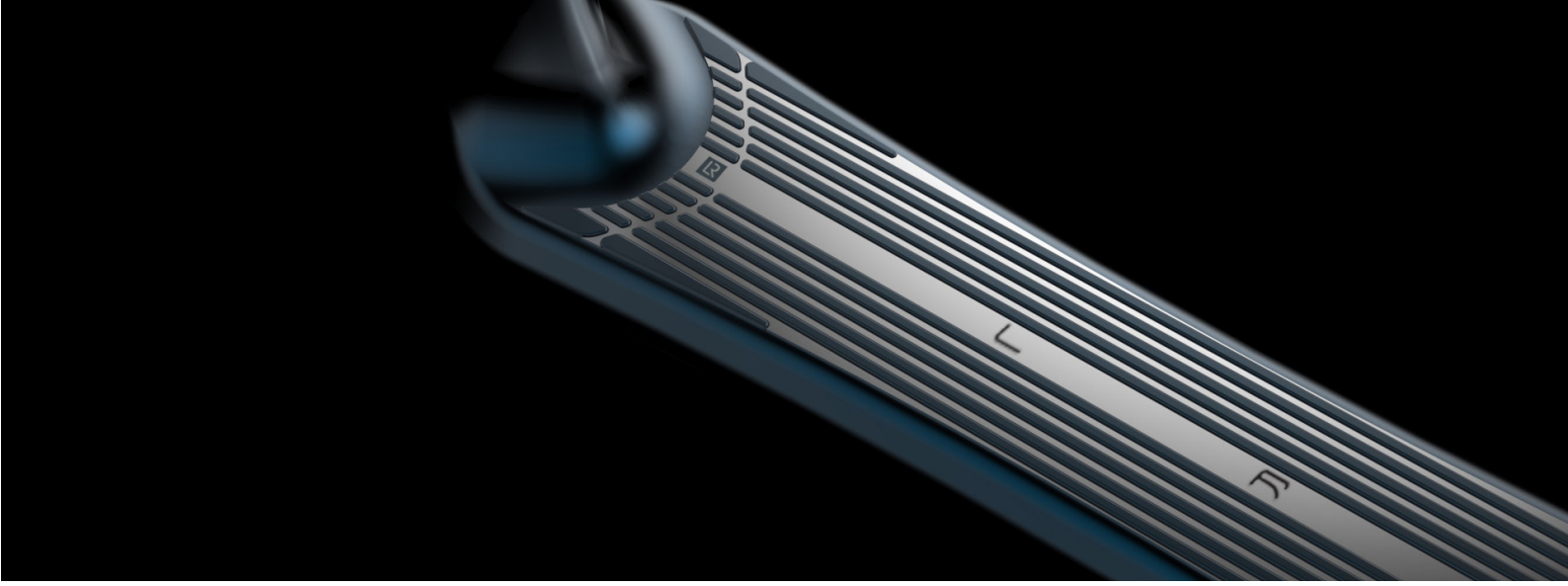
We found four main insights during our research:

- **Design engagement:** Learning that we needed to build confidence between designers and stakeholders to work together. We achieved this through sharing drawings, model, protoypes and used feedback and field trips to enhance discussion and observation.

- **Applying proven methods:** We applied proven and tested design methods of action research and participatory design to a new situation through two design challenge with new partners and stekeholders.

- **Creative risk vs. risk to life:** Through engaging with the design groups and reflecting on conversations we learnt that increasing creative risk opens up new options and possibilities for improviong safety and design. This approach would not normally be selected for a safety-risk critical environment.

- **Visual risk and confidence:** The design teams used industrial feedback between users to generate the insight that visual confirmation of safety was crucial to mitigating risk. This insight illustrates that visual communication design through signs, structures, materials and interfaces can reduce risk to life.



Dynaweb (© Chia Cheng, Kung, Chih-Hsing Huang, Irene Chiu, Nick Hooton)

The Safety Grand Challenge explored a new territory for design, which took shape around the relationship with risk in the specific context of safety at sea. This generated a new approach to design methodologies, which led to the construction of a design for risk framework in which both parties are linked by a combined and mutual relationship. The combination generated a new kind of design approach to current risk assessment analysis. Nonetheless such a particular and unique approach would not have been possible if the interdisciplinarity, research, education and consistent engagement of experts from industry was not integrated onto the process. The right balance among the parties formed an ecosystem of factors, in which each interacted with the others with the common intent to generate innovation in the field.

During the Safety Grand Challenge the interactions of different disciplines, practices and expertise of the designers, researcher-tutors and partners resulted in eight pioneering innovations, ranging from product-focused to systemic solutions, cutting edge material and manufacture techniques and educational strategies. This diversity reflects the success of complexity in the context of this research, as it helped to articulate and elaborate the topics and kept experts from different industries regularly engaged in the research process through the lens of their expertise. It follows that design for risk can be defined as a creative territory, where collaboration is the method that guides the involved parties to rethink risk procedures by means of communication, mutual understanding and creativity.

By working on the Safety Grand Challenge we found that framing risk in a combined physical-physiological context prepares the territory for technological innovation. Together these factors can change people's behaviour and perception of risk, whether directly or indirectly involved. The variety of the eight projects visualises how collaboration and participation helped to shape trust among the involved parties - who offered different lenses to look at the problem - by becoming the common ground of examination. Trust became "participative creativity", which lead to technological innovation.

Indeed our findings define the infrastructure of design for safety, i.e. the network of people and technologies that together investigate custom solutions that understand the context and behave accordingly. As researchers we didn't aim to form a new universal approach, which would solve any kind of risk around the maritime world. Our intention was to look at specific scenarios and, by common methodologies, to generate unique solutions that put people first.

These insights show that there is potential to use creative risk to tackle complex safety scenarios, even though it is necessary to acknowledge the context where risk takes place to identify the different kinds of complexities. We understood this by weaving together teaching and researching. Even though we started from an accepted method of research, we gradually shaped a new one based on the experience we built along the process. We kept a consistent "responsive mode" of collaboration with partners and stakeholders which became the basis of a new design for risk approach. Creative risk is the outcome and as approach capable of tackling complex and diverse

Postgraduate designers presentation at the RNLI College (@RNLI)

problems around the world that employs cutting-edge technology, ranging from material, automated systems and digital platforms.

One of the key insights we learnt concerns the support of creative risk, which reduces the likelihood of risk events. Indeed greater creative risk in experimental thinking is more likely to lead to contextually effective concepts that can increase real world safety.

When considering the combined findings there is the begining of a new territory for design to explore risk using non-traditional methods and including the social and behavioural alongside design understandings of creative technology uses. Seeing risk as a design terrain allows us to bring in new thinking from other diverse design areas to tackle safety by recognising the complex interrelated ecosystems between people and machines. A particular aspect of this is the circular feedback loops that can help us see risk environments as continuous areas of combined interdisciplinary effort rather than sets of prescribed regulations.

Recommendations

Through our exposure to the maritime and rescue industry we believe that there will be many more design safety opportunities that can be tackled and that future opportunities for using design thinking in safety scenarios could be applied to a range of different strategic conditions. There lies much more potential in how design can bridge the space between equipment and technology usage and the human factors of behaviours and perfomance.

Improving communications, using behaviour change techniques, understanding, creative risk and deploying participatory and co-design tools are all methods with potential to make significant risk reductions. As technologies advance, emerging industries will come across new emergent risks that may be be tackled through learnings from mature industries or these may need new approaches or a combination of both. However a framework in which design can tackle future safety scenarios at a strategic level has yet to be developed. Our main recommendation is that design is a partnership to reduce risk and not a replacement or an alternative viewpoint. Design thinking is most powerful when it is in collaboration and embedded in real life situations.

Dissemination

8 Design projects (7 completed)

2 Conference papers accepted to international conferences

- "Encouraging Creative Risk to Reduce Risk to Life", EPDE 2017, Oslo Norway
- "Collaborating Design Risk", IASDR 2017, University of Cincinnati, Ohio, USA

4 Exhibitions

- **Lloyd's Register Foundation**
  21-24 February 2017
  71 Fenchurch Street
  London
  EC3M 4HH

- **HQS Wellington for IMPA Conference**
  8-10 March 2017
  Victoria Embankment
  London
  WC2R 2PN

- **LR Global Technology Centre**
  11 March-25 April 2017
  Burgess Rd
  Southampton
  SO16 7Q

- **RNLI College**
  27 April - 4 May 2017
  W Quay Rd
  Poole
  BH15 1HZ

2 Symposia:

- **Lloyd's Register Foundation**, London
  21 February 2017
- **RNLI College**, Poole 27 April 2017

1 Film of design team experiences.

The Safety Grand Challenge team: RCA postgraduate designers and staff (@LRF)

References

AcrossRCA, http://across.rca.ac.uk/ [Accessed April 28th 2017]

Buchanan, R. "Wicked problems in design thinking." Design Issues 8.2 (1992): 5-21.

CHIRP Maritime, www.chirpmaritime.org, [Accessed April 28th, 2017]

Cross, N. (1982) 'Designerly Ways of Knowing' Design Studies vol 3 no 4 October 1982 pp. 221-227

Foth, M., & Axup, J., (2006). Participatory Design and Action Research: Identical Twins or Synergetic Pair? In Jacucci, G, Kensing, F, Wagner, I, & Blomberg, J ,(Eds.) Participatory Design Conference 2006: Expanding Boundaries in Design, August 1-5, Trento, Italy.

Hall, A. & Childs, P. (2009). Innovation Design Engineering: Non-linear progressive education for diverse intakes. International Conference on Engineering and Product Design Education, September 10-11, University of Brighton, UK, pp 312-317.

Health & Safety Executive (2016) Design Codes - Jetties

Hignett, H. 21 Centuries of Marine Pilotage: The History of the United Kingdom Maritime Pilots' Association, 2012 (Jeremy Mills Publishing, UK)

Hofstede, G., (2011) Dimensionalizing Cultures: Hofstede Model in Context. Online Readings in Psychology and Culture, 2(1). http://dx.doi.org/10.9707/2307-0919.1014

Kimbell, L. (2009). Design practices in design thinking. European Academy of Management, 1-24.

Kolko, J. (2015). Design Thinking Comes to an Age. In Harvard Business Review, September 2015, https://hbr.org/2015/09/design-thinking-comes-of-age [Accessed April 28th 2017)

International Maritime Organization (2011) Resolution A.1045(27) Pilot Transfer Arrangements

International Chamber of Shipping (2008) Shipping Industry Guidance on Pilot Transfer Arrangements: Ensuring Compliance with SOLAS

IMPA, www.impahq.org, [Accessed April 28th, 2017]

Lewin, K. (1946) Action research and minority problems. J Soc. Issues 2(4): 34-46.

Lloyd's Register Foundation, (2014) Lloyd's Register Foundation Review 2014, 1

Lloyd's Register Foundation, (2016) Making and Impact: Lloyd's Register Foundation Review 2016, pp2

Lloyd's Register Foundation, (2016) Five Year Plan 2016-2021, pp2

Lu, S and Liu, A, (2012) "Abductive Reasoning for Design Synthesis," CIRP Annals - Manufacturing Technology Vol. 61: 143–146;

Mayor of London (2016) City in the East

Mayor of London (2014) Homes for London: The London Housing Strategy, pp7

Mayor of London/Transport for London (2013) River Action Plan

OED Online. March 2017. Oxford University Press [Accessed 3 June 2017].

Ovink, H., (2016), Hurricane Sandy. Reform by Design, LSECities, https://lsecities.net/media/

objects/articles/hurricane-sandy-reform-by-design/en-gb/ [Accessed April 28th 2017)

Pecha Kucha, FAQ, http://www.pechakucha.org/faq[Accessed April 28th. 2017]

Port of London Authority, (2015) Thames Vision: Consultation on Priority and Actions

Port of London Authority, (2017), The Thames Vision, in http://www.pla.co.uk/About-Us/The-Thames-Vision [Accessed 29th April 2017]

Rittel, H.W.J. & Webber, M.M. Policy Sci (1973) 4: 155. doi:10.1007/BF01405730

Rittel, Horst W. J.; Melvin M. Webber (1973). "Dilemmas in a General Theory of Planning" (PDF), Policy Sciences. 4: 155–169.

RNLI (2016) Respect the Water http://www.respectthewater.com/ [Accessed 28th April 2017]

RNLI (2016) Big Sick, Little Sick: Simpler ways to treat injury and illness at sea http://magazine.rnli.org/Article/Big-Sick-Little-Sick-Simpler-ways-to-treat-injury-102 [Accessed 28th April 2017]

RNLI Lifeboats, (2017) https://rnli.org/what-we-do/lifeboats-and-stations/our-lifeboat-fleet [Accessed 29th April 2017]

RNLI College, (2017), Lifeboats, http://college.rnli.org/training/Pages/training.aspx?utm_source=rnli_mainsite&utm_medium=body_link&utm_content=support_us_visit_college [Accessed 29th April 2017]

RNLI, An Exercise on the Thames in 360 video, https://www.youtube.com/watch?v=zle2iMFc8hg, [Accessed April 28th, 2017)

Sennett, R., (2013), The Open City, in https://www.richardsennett.com/site/senn/UploadedResources/The%20Open%20City.pdf

SOLAS (2012) Regulation 23 - Pilot Transfer Arrangements

Spinuzzi, C., (2005) The Methodology of Participatory Design. Technical Communication 52(2) May 2005. 163-174

Tipton, M., Wooler, A.(2016) The Science of Beach Lifeguarding, Edition: 1st, Chapter: 6, CRC Press Inc

World Wildlife Foundation (2008) Thames Basin Vulnerability Report Technical Summary

Appendices

Appendix 1: Safe Ship Boarding

Objects & Products

Pilot Ladders

Wikipedia, Jacob's Ladder, https://en.wikipedia.org/wiki/Jacob%27s_ladder_(nautical) [Accessed 1st Sept 2016]

The Shipowners Club (2016) Maintenance of pilot ladders

Wikipedia, Pilot Ladder, https://en.wikipedia.org/wiki/Pilot_ladder [Accessed 1st Sept 2016]

Davidson, P (2014) Pilot Ladder Checks Save Lives, Money, SKULD

BrightHub Engineering, Role of Pilot Ladders on Ships, http://www.brighthubengineering.com/seafaring/49172roleofpilotladderonships/#imgn_0 [Accessed 1st Sept 2016]

Wilson, B, Legget, C, (2010) Pilot Ladder Safety, Standard Safety

Safety4Sea, Pilot Transfer Arrangements: Use of pilot ladders, http://www.safety4sea.com/pilottransferarrangementsuseofpilotladders/ [Accessed 1st Sept 2016]

Prior Art

Patent Application 2020120012390, 2014

Patent Application CN2687005Y, 2005

Patent Application CN203005698U, 2013

Popular Mechanics (1953) Modern Pilot Ladder Has Rungs That Allow Quick Repair

Patent Application US1962890, 1934

Patent Application US4003473, 1977

Patent Application US4115887, 1978

Patent Application US4241809, 1980

Patent Application US4412598, 1983

Patent Application US4554996, 1982

Patent Application WO2000044614A1, 2000

Training & Education

Shattock, M, Tipton, M, (2012) Autonomic conflict: A different way to die during cold water immersion, The Journal of Physiology, 590.14, pp 3219–3230

International Maritime Pilots' Association, (2012) Required Boarding Arrangements for Pilot

Tipton, M., Wooler, A.(2016) The Science of Beach Lifeguarding, Edition: 1st, Chapter: 6, CRC Press Inc

Szpilman D, Tipton M, Sempsrott J, Webber, J, Bierens J, Dawes P, Seabra R, Barcala-Furelos R, Queiroga A C (2016) Drowning timeline: a new systematic model of the drowning process, American Journal of Emergency Medicine

North of England P&I Assoc. (2013) Loss Prevention Hot-Spots: Pilot Ladder

IMPA (2010) Safety Campaign

Tipton, M, Milligan, G (2016) Mind the Gap: Considerations on Swift Water Rescue, Emergency Service Times pp49

IMO (2007) Resolution A.960: Recommendations on Training and Certification and operational procedures for maritime pilots other than deep sea pilots

CHIRP (2015) Pilot Ladders: Familiarity breeds neglect, Safety at Sea pp38

Rose, J (2015) Understanding the Human Factor, Safety at Sea, pp38

Embedded Knowledge

Bloor, M (2008) Fatalities at Sea: The good and the bad news, The SIRC Column, The Sea

Marine Insight, How Is Rigging and Maintenance of Pilot Ladder Done on Ships? http://www.marineinsight.com/guidelines/maintenancepilotladder/ [Accessed 1st Sept 2016]

The Maritime Executive, Lack of Procedure Led to Fatal Gangway Accident, http://maritime-executive.com/article/lack-of-procedure-led-to-fatal-gangway-accident [Accessed 1st Sept 2016]

IMRF(2016) Lifeline Newsletter

BrightHub Engineering, Role of Pilot In Ships, http://www.brighthubengineering.com/seafaring/44060roleofpilotinships/?p=2 [Accessed 1st Sept 2016]

Wikipedia, Maritime Pilot, https://en.wikipedia.org/wiki/Maritime_pilot [Accessed 1st Sept 2016]

SeaNews, Maritime Pilots are modern traditionalists... http://www.seanews.com.tr/news/133382/ [Accessed 1st Sept 2016]

ShipTechnology, Safe Hands: The Role of the Maritime Pilot, http://www.shiptechnology.

com/features/ [Accessed 1st Sept 2016]

Singh, W (2016) Securing Pilot Ladders, Seaways, pp 6-8

Professional Mariner, Shaken by deaths in their ranks, pilots scrutinize their practices and equipment, http://www.professionalmariner.

com/May2007/ [Accessed 1st Sept 2016]

Procedures & Regulations

Pilot Transfer Regulations

IACS (2014) Boat Transfers Safe Practice

HSE (2007) Guidance on procedures for the transfer of personnel by carriers

Maritime Safety Agency (1999) MGN 50 (M) Manning of Pilot Boats

HSE (2009) Memorandum of Understanding between the HSE, the MCGA and the MAIB for health and safety enforcement activities etc at the water margin and offshore

IMO (2011) Resolution A.1045(27) Pilot Transfer Arrangements

IMPA (2012) Shipping Industry Guidance on Pilot Transfer Arrangements Ensuring Compliance with SOLAS

MCA (2011) MGN 432 (M+F) Safety during Transfers of Persons to and from Ships

SOLAS (2012) Regulation 23 - Pilot Transfer Arrangements

Merchant Shipping (1987) No. 1961 The Merchant Shipping (Pilot Ladders and Hoists) Regulations

Pilot Ladder Design & Setup

MCA (2004) Chapter 17 Pilot Ladders and Hoists

Johnston, I, (2015) Pilot Ladders Compliance with the Standard

IMO (2011) Resolution A.1045(27) Pilot Transfer Arrangements

Accident Reports

Reports

CHIRP (2015) CHIRP Maritime Feedback, Issue No. 38

Rose, J, (2015) Bringing Safety to Life Poster, CHIRP

Shell Marine Contractors (2013) Step Change for Safety - Global Sharing

Anecdotes

Australian Transport Safety Bureau (2014) Fall from pilot ladder highlights risks, Australian Government

Aerossurance, Marine Pilot Transfer Winching Accident, http://aerossurance.com/helicopters/mptwinchingaccident/ [Accessed 1st Sept 2016]

Sweeney, K (2008) More needs to be done to protect pilots during transfers, Professional Mariner

Maritime Accident Casebook, Pilot Fall Due to Worn Ladder, http://maritimeaccident.org/2011/08/pilotfallduetowornladder/#more16860 [Accessed 1st Sept 2016]

UKMPA, Three Pilot Ladder Incidents, http://www.ukmpa.org/newsarticle.php?news=296 [Accessed 1st Sept 2016]

General Reports

IMRF(2016) Lifeline Newsletter

Timpson, I (2014) Marine Accident Data Study 2012: Report of Findings, Port Skills and Safety

Weigall, F (2006) Marine Pilot Transfers- A preliminary investigation of options, Australian Transport Safety Bureau

Sampson, H., Acejo, I., Ellis, N., Tang, L., Turgo, N. (2016) The relationships between seafarers and shoreside personnel: An outline report based on research undertaken in the period 2012-2016, Cardiff University

Methods&Solutions

Alternative Transfer

Germanischer Lloyd (2011) Rules for Classification and Construction, Industrial Services, Offshore Technology, Guideline for Personnel Transfers by means of Lifitng Appliances

DHS Marine Group (2011) Guidelines/Recommendations on Personnel Transfer using Ship's Cranes and Personnel Baskets

Marine Transfer Forum (2016) Offshore Personnel Transfer by crane, Best Practice Guidelines for Routine and Emergency Operations

Step Change In Safety (2014) Marine Transfer Of Personnel

North Star Shipping IMS, 7.4.13 - Personnel Transfer Basket , http://ims.craiggroup.com/section58/7.4vesseloperations/7.4.13personneltransferbybasket/ [Accessed 1st Sept 2016]

Megeed, J (2015) Personnel Transfer by Crane, Oil Companies International Marine Forum

Standard Safety (2010) Personnel Transfer Usings Ship's Cranes, Charles Taylor Consulting

Reflex Marine (2014) Transfer Basket Brochure

Loss Prevention Bulletin (2014) Transfers By Personnel Basket, West of England Insurance Services

Innovations

CyClaDes (2015) Assessing the human element in ship design and operation

Salvare Worldwide, Illuminated Pilot Ladder, https://www.salvare.co.uk/pilotladder.php [Accessed 1st Sept 2016]

Next Generation Marine Power & Propulsion, (2016) Conference Timetable

CyClaDes (2015) Risk Assessment and Crew Performance Prediction

The Guardian, Royal Navy tests unmanned speedboat ahead of drone exercises, https://www.theguardian.com/world/2016/sep/05/ [Accessed 6th Sept 2016]

Rose, J (2015) Understanding the Human Factor, Safety at Sea, pp38

CNN, Self-driving boats to be unleashed in Amsterdam http://edition.cnn.com/2016/10/12/design/self-driving-boats-mit/index.html [Accessed 2nd Sept 2016]

Appendix 2: Thames Safest River 2030

Community

Thames

British Marine Federation (2013) Cruising Guide to the River Thames

Reclaim the Beach, Free Party By The River Thames In Front Of The Royal Festival Hall, London UK, http://www.urban75.org/london/reclaim.html [Accessed 2nd Sept 2016]

Olympic Delivery Authority (2016) H10 And H14 'Western Bridges' Olympic Park

Port of London Authority, Key Events, http://pla.co.uk/Events/KeyEvents [Accessed 2nd Sept 2016]

Greenspace Information for Greater London, Key London Figures, www.gigl.org.uk/keyfigures, [Accessed 2nd Sept 2016]

Wikipedia, London Bridge, ttps://en.wikipedia.org/wiki/London_Bridge#Old_London_Bridge, [Accessed 2nd v 2016]

Geocases, London Dockland: An Update, http://www.geocases2.co.uk/londondocks1.htm, [Accessed 2nd Sept 2016]

Mayor of London (2014) Homes for London: The London Housing Strategy,

GoLondon, Mudlarking in London on The Thames, http://golondon.about.com/od/londonforfree/fr/MudlarkingInLondon.htm [Accessed 2nd Sept 2016]

London Docklands Development Corp., (1998) Regeneration Statement

Wikipedia, River Thames Frost Fairs, https://en.wikipedia.org/wiki/River_Thames_frost_fairs [Accessed 2nd Sept 2016]

London City Hall (2016) Sadiq Khan: Building Bridges Rather Than Walls

Wikipedia, The Boat Race, https://en.wikipedia.org/wiki/The_Boat_Race [Accessed 2nd Sept 2016]

Tide Line Art, The Holy River Thames, http://www.tidelineart.com/tidelineart-blog/the-holy-river-thames, [Accessed 2nd Sept 2016]

River Thames Society, Tidy up the Thames & more, http://www.riverthamessociety.org.uk/campaigns.aspx [Accessed 2nd Sept 2016]

Port of London Authority, Time to Have Your Say on the Thames' Future, https://www.pla.co.uk/TimetoHaveYourSayontheThamesFuture[Accessed 2nd Sept 2016]

Nathan, M, (2013) We need a more realistic development plan for the Thames Gateway, LSE, http://blogs.lse.ac.uk/politicsandpolicy/thisisnotagateway/ [Accessed 2nd Sept 2016]

This Is Money, What you need to know about buying a canal boat and living on it - http://www.thisismoney.co.uk/money/mortgageshome/article3084373/livingfractionbricksmortarsnotplainsailing.html [Accessed 2nd Sept 2016]

Rogers, B. (2013) Whatever happened to the Thames Gateway, Centre for London http://centreforlondon.org/whateverhappenedtothethamesgateway/ [Accessed 2nd Sept 2016]

Other Rivers & Seafronts

Master in Regenerating Intermediate Landscapes, 10 Waterfront Regeneration Projects Around the World, https://intermediatelandscapes.com/2011/10/26/10waterfrontregenerationprojectsaroundtheworld/ [Accessed 2nd Sept 2016]

YourAmazingPlaces, 19 Amazing Pictures of Giethoorn Village Without Roads, http://www.youramazingplaces.com/19amazingpicturesofgiethoornvillagewithoutroads/ [Accessed 2nd Sept 2016]

Dezeen, BIG stacks shipping containers to create floating student housing, https://www.dezeen.com/2016/09/22/big-bjarke-ingels-shipping-containers-floating-student-housing-urban-rigger-copenhagen/ [Accessed 2nd Sept 2016]

Sanoff, H. (2003) Community Participation in Riverfront Development , North Carolina State University

Wikipedia, Floating market, https://en.wikipedia.org/wiki/Floating_market [Accessed 2nd Sept 2016]

Project for Public Spaces, Great Waterfronts of the World, http://www.pps.org/reference/greatwaterfronts/ [Accessed 2nd Sept 2016]

People of Our Everyday Life, Hindu Ritual Bathing, http://peopleof.oureverydaylife.com/hindu-ritual-bathing-6832.html [Accessed 2nd Sept 2016]

Wikipedia, Paris-Plages, https://en.wikipedia.org/wiki/ParisPlages [Accessed 2nd Sept 2016]

TechInsider, Inside Thailand's hauntingly gorgeous 'Loy Krathong' festival of lights,http://www.techinsider.io/thailoykrathongfestival201511 [Accessed 2nd Sept 2016]

River Safety & Communication

Rogers, B, (2012) Dirty Old River, Prospect Magazine

The Economist (2013) Full Metal Riverside

Healthline News Preventing Suicide, One Blister Pack and Bridge Barrier at a Time, http://www.healthline.com/healthnews/eoneblisterpackandbridgebarrieratatime121615 [Accessed 2nd Sept 2016]

Transport for London, River Thames 2020 - Industry brought together to explore the future of river travel in London, https://tfl.gov.uk/infofor/media/pressreleases/2013/october/industrybroughtgethertoexplorethefutureofrivertravelinlondon [Accessed 2nd Sept 2016]

RNLI, RNLI Respect the Water campaign targets accidental drowning along the coast, https://rnli.org/news-and-media/2016/june/08/respect-the-water-campaign-targets-accidental-drowning-along-the-coast [Accessed 2nd Sept 2016]

Totally Thames, RNLI Saving Lives on the Thames, http://totallythames.org/blog/savinglivesonthethames [Accessed 2nd Sept 2016]

History Today, Taming the Thames, http://www.historytoday.com/rogerhudson/tamingthames [Accessed 2nd Sept 2016]

LSE London (2008) The Thames Gateway: building a new city within an old one?

Port of London Authority (2015) Thames Vision: Consultation on Goals and Priority Actions

The Independent (2010) Thames, The tale that the river told

Thames Gateway (2009) The Delivery Plan

London Evening Standard (2016) Waterloo Bridge to be patrolled by volunteers to intercept suicide jumpers

Regulation & Innovation

British Marine Federation (2013) Cruising Guide to the River Thames

Health & Safety Executive (2016) Design Codes - Jetties

Black&Veatch (2014) Innovation in flood risk management

Christensen, C, Hall, T, Dillon, K, Duncan, D (2016) Know Your Customers' "Jobs to Be Done", Harvard Business Review

Marine Guidance Note (1999) Launching of Lifeboats Guidance

Future Buildings (2007) Living With Water - Visions of a Flooded Future, RIBA

PLA (2013) Management and Operation of Commercial Vessels

Dezeen, Oscar Medley-Whitfield and Harry Trimble at Designers in Residence, https://www.dezeen.com/2012/11/18/oscar-medley-whitfield-and-harry-trimble-at-designers-in-residence-2012/ [Accessed 2nd Sept 2016]

USEPA (2014) Promoting Technology Innovations for Clean and Safe Water

TfL, River Thames 2020 - Industry brought together to explore the future of river travel in London https://tfl.gov.uk/infofor/media/pressreleases/2013/october/togethertoexplorethefutureofrivertravelinlondon [Accessed 2nd Sept 2016]

CNN, Self-driving boats to be unleashed in Amsterdam http://edition.cnn.com/2016/10/12/design/self-driving-boats-mit/index.html [Accessed 2nd Sept 2016]

The Guardian, Story of cities #future_ what will our growing megacities really look like, https://www.theguardian.com/cities/2016/may/26/ [Accessed 2nd Sept 2016]

BBCNews, Thames Barrier engineer says second defence needed http://www.bbc.co.uk/news/ukenglandlondon20904885 [Accessed 2nd Sept 2016]

Fact & Figures

British Marine Federation (2013) Cruising Guide to the River Thames

Health & Safety Executive (2016) Design Codes - Jetties

PLA, Inner London Map, http://www.pla.co.uk/assets/NEW_Inner_PRINT_FINAL.pdf [Accessed 2nd Sept 2016]

Marine Guidance Note (1999) Launching of Lifeboats Guidance

Lost London Underground Rivers, https://cassstudio6.wordpress.com/historical-development/[Accessed 2nd Sept 2016]

PLA (2013) Management and Operation of Commercial Vessels on the Thames

PLA, Tidal Thames: Recreational Users Guide, http://www.pla.co.uk/assets/Outer_PRINT_FINAL.pdf [Accessed 2nd Sept 2016]

World Wildlife Foundation (2008) Thames Basin Vulnerability Report Technical Summary

LSE London (2008) The Thames Gateway: building a new city within an old one?

Port of London Authority (2015) Thames Vision: Consultation on Goals and Priority Actions

Wikipedia, Tributaries of the River Thames, https://en.wikipedia.org/wiki/Tributaries_of_the_River_Thames [Accessed 13th Sept 2016]

Behaviour-Experience

Sairinen, R (2006)Assessing social impacts in urban waterfront regeneration - Environmental Impact Assessment Review, University of Eastern Finland

Munroe, M, (2015) Can Education Change Behavior?, School of Forest Resources and Conservation, University of Florida

RNLI (2016) Educational Material Catalogue

Maitland, R (2010) Everyday life as a creative experience in cities, University of Westminister

Project for Public Spaces, How to Transform a Waterfront, http://www.pps.org/reference/turnwaterfrontaround/ [Accessed 13th Sept 2016]

Best Colleges Online, The Science of Getting Drunk, http://www.bestcollegesonline.org/drinking/ [Accessed 13th Sept 2016]

London Evening Standard, Thames lifeboat sees huge number of New Year's Eve call-outs 'due to drunk people' http://www.standard.co.uk/news/london/thames-rnli-lifeboat-sees-huge-number-of-new-years-eve-callouts-due-to-drunk-people-a3149011.html [Accessed 13th Sept 2016]

PLA, Thames marine training and skills to be stepped-up, https://www.pla.co.uk/Thamesmarinetrainingandskillstobesteppedup, [Accessed 2nd Sept 2016]

Canal & River Trust (2013) Water Safety Lesson Plan

Cheek, N, Coe-Odess, S, Schwartz, B, (2015) What have I just done? Anchoring, self-knowledge and judgements of recent behaviour, Judgment and Decision Making, Vol. 10, No. 1, January 2015, pp. 76–85

Hughes, M, Weiler, B, Curtis, J (2012) What's the Problem, River Management, Education and Public Beliefs, Royal Swedish Academy of Sciences

Appendix 3: Meeting Notes

RNLI videoconference with Will Roberts, 5th August 2016

Pilot Ladder Transfers

Look at wind farms, getting crews safety onto offshore wind farms.

Could be extrapolated onto our project.

Buffer structures.

Variability in sea state.

Up to 1.5m fine.

Above gets harder.

Bow-on to turbine and jump off.

Danish yachts look the 'swath' – like a catamaran with ballast tanks for stability.

RNLI Challenge Transfers & Cockpit Design

Yacht approaches listing heavily getting people on and off.

If boat is listing to port why not come in from keel side?

Challenge cannot cut power to lifeboat as it has to keep moving and stable.

This issue not that frequent but hard to practice.

It's a risk but not necessarily a big problem.

When rescuing RNLI are in a high performance state so less risk.

Most incidents are actually on the way, preparation and off-call.

Have paper for optimum way to scan navigation equipment to make this easier and will send.

Looking at designing a cockpit to help facilitate better transfers.

Industrial best practice on this available.

New faster boats adds higher cognitive load with navigation and other data inputs.

How can we plot safest verses fastest routes?

This is opposite approach to operational issues led.

Will send us a paper on this.

Thames Futures

Used future agenda fir future scoping workshop led by Tim Jones (ex IDE).

Have outcome of Thames review with stakeholders inc. fire, police, TFL, port authority etc.

Current, future risks and projection.

Tower Bridge to Gravesend will increase in population riverside more than city of Edinburgh.

Overall big increase in recreation and traffic.

CHALLENGE: How can RNLI and partners make that stretch of water the safest in the world?

London port authority very keen to be involved and see this.

400 deaths on water inland every year.

Other:

RNLI have funds for parallel projects £10-20k.

How can architecture nudge and influence behaviour change on waterways.

Laura and Mike book a visit 2 hours etc. with Will.

Laura and Mike discuss 3 month case study communications project with RNLI on how design thinking affects the organisation. Video blogging, inputs for the organisation.

Lloyd's Register Innovation Centre, 11th August 2016

The meeting was convened by Dr. Vanessa Forbes, from Lloyd's Register and Professor Ashley Hall, from the RCA. It included a range of highly experienced maritime industry experts and three members of the project team from the College. The following field notes include paraphrases and reflections that were taken during and immediately after the meeting by Robert Pulley (Dr. Laura Ferrarello, Chang Hee Lee and Professor Ashley Hall). A new set of questions may emerge from these notes and, in turn, this may inform further discussion. The process is designed to provide a starting point for further client meetings and student briefings.

Other attendees:

Richard Battley LRF, Alan Swinbank LRF Principal Surveyor S. UK, Chris Hoyle Portsmouth Pilotage ABP (Associated British Ports) & Marine Pilot Authority (MPA), Capt. Andrew G. Moll MAIB Marine Accident Investigation Branch, Pippa Moody Navy Command Marine Services,Capt. Rakesh Pandit MCGA Marine and Coastguard Agency

Agenda:

Welcome and Introduction to LRF, Vanessa Forbes , 5 mins

Introduction to Royal College of Art and this Grand Challenge, Ashley Hall,15 mins

Defining the problem – size and context (craft, weather, locations etc) Ashley Hall,20 mins

Barriers to innovation – structured session, Ashley Hall, 25 mins

Innovation ideas, Ashley Hall, 20 mins

Wrap up and thank you, Vanessa Forbes, 5 mins

Quote: "Look at the changes that have taken place in the building industry, a difficult sector in which to implement change - this illustrates that change can be managed and does happen."

Comment: The project may benefit from a review of change theory and an inclusive method for engaging stakeholders. There were differences of attitude and opinion across the board during the meeting which made the experience very rich.

Other sectors including aviation, formula one, the fire service, and mountaineering were mentioned as areas for potential technology transfer. Areas within the sector of potential interest included the Navy (Special Boat Service?), off-shore wind generation, oil rigs, cruise ships, and the RNLI. Less obvious areas of potential value include circus performers, such as Cirque de Soleil, and other sports such as windsurfing and kite surfing.

Quote: "This industry is very much about 'Grandfathering' and as such is resistant to change."

Comment: Piloting is a tradition that has very deep roots. There is no desire to see significant change in the design of ladders by Chris the Pilot or his colleagues. Our assumption was that the term 'Grandfathering' referred to the

passing down of practice and custom through the generations. There is also a legal definition related to a "grandfather clause":

"An exception to a restriction that allows all those already doing something to continue doing it even if they would be stopped by the new restriction." Thus, "grandfathering" is allowing an existing operation or conduct to continue legally when a (similar) new operation or conduct would be illegal."

Quote: The wood and rope ladders, most commonly used in the UK, are preferred by most pilots. The detailed 'whipping' of the rope is important when it comes to the grip when climbing the ladder. I have tried climbing ladders made of plastic and nylon and these stretch and are less stable. Most Pilot ladders are not manufactured in the UK today and cost around £300 assembled and finished to appropriate international safety standards.

Comment: Subsequent discussion focused, for a short period of time, on what the international standards are and whether there is an industry sector list on which ladder performance is measured against key criteria – a kind of 'Which' report (potential information gathering and visual communication project?). The advice given was to talk to the manufacturers (add to this pilots). It was thought that ladders are invariably made in China or East Asia. The majority of the team were surprised at how little these vital pieces of kit cost (Possible 'Lloyd's Register Approved' ladder system that is a higher specification and quality?).

Further discussion between members of the team focused upon the tactile quality of materials and our tacit knowledge of materials such as wood, rope and the skilled craftwork. When the major risk relates to maintenance and repair of the rig by the crew on board a vessel, visual appearance of weathering and wearing is an indicator of the how seriously matters of safety are taken.

Quote: "In Japan, the pilot boat is very powerful and is driven, nose first, hard up against the hull of a ship. The idea is to 'force' the two vessels together."

Comment: Researching cultural conventions to establish safe practice would be a worthwhile exercise. What does 'bow to hull' contact look like in detail and is there a design opportunity here? Transferring such practice may be easier to propose than to see adopted. How to test new ideas and build a network of early adopters of improved practice is a critical part of developing an improved system. While this is common practice in other sectors, including aviation and Olympic sport, the maritime sector is not so closely regulated and compliance is difficult to monitor. This may be, in part, because of a relative lack of investment in the industry.

Quote: "I am not clear why the RCA have been invited to do this and I advise caution. Many 'new' ideas have been seen before. If there was an easy answer it would have already been found."

Comment: The question 'Why RCA?' did not arise again following Ashley's slide presentation

which explained the history of the College, listed international organisations IDE has worked with, and illustrated selected, recent case study examples of research work and graduate work.

The expert group were far more relaxed and open following Ashley's introduction. It was clear that there were unspoken issues between the professionals who had been invited to the meeting and the thrust of the project initiated by Lloyd's Register. It is difficult to know the main cause of this although concerns related to an unknown and uncertain future in a rapidly changing world of new communication and control technologies may be part of the reason.

Quote: "Why are Pilots needed at all bearing in mind that the aviation industry has adopted an automatic piloting of aircraft?"

Comment: This question was asked by an expert (what is his role in the industry?). Discussion around this 'meta' issue focused upon the lack of investment relative to the aviation industry. There was also a sense that, as the maritime industry has been working effectively (?) for hundreds of years and the knowledge passed on from generation to generation has stood the test of time, why change anything? The industry is considered to be conservative by the consensus of expert opinion in attendance at the meeting. A high level of knowledge and skill is maintained, by committed professionals, through custom and practice. Nurturing trust is critical and may be difficult because change is inevitable. It may be difficult to build the necessary level of goodwill and to win the hearts and minds of all concerned. Managing client expectations while maintaining the preferences of stakeholders may be difficult when the client is looking for radical innovation. One way to avoid this may be to offer ideas that include incremental product development, improving services and systems in the short term and proposing more radical innovation for the longer term. It is worth reflecting upon the fact that it took five years for a safety poster to be adopted internationally (what is this poster and why did it take so long?).

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generate provocative ideas – "What about an Archimedes Screw?" – this seemed to help team bonding in a light-hearted way.

Quote: "The elephant in the room seemed to be the potential change to the role of a Pilot as a result of innovation and the impact this might have on current professional practice."

Comment: A question asked by one of the experts was; "What do you expect to achieve in four months?" and his advice was; "Keep the project realistic and the objectives clear. "

On one level this is sound and sensible advice but it may also mean that step-change would not be welcomed, particularly when advice is coming from a group of people with little or no maritime experience – people who 'may be getting ahead of themselves'. This attitude was, unmistakeably, in contrast with those representing Lloyd's Register. Keeping everyone onside will be a difficult ask and that requires some reflection and strategic thinking.

Developing ideas at the 'meta', strategic level and the operational level is worth careful consideration. There are several different audiences with conflicting ideas about what is appropriate and what is sacrosanct. Within such a sensitive political and managerial environment, it is important to maintain an open discussion. If we are to build a climate of trust then it may be more effective if key members of the stakeholder innovation group share a basic sense that nothing is sacrosanct that working creatively is welcome. Selecting a non-probability participant group, for further discussion and maybe co-designing, was raised by Vanessa and Richard and they speculated on other professionals from other sectors that might help develop an innovative culture within a relatively tight time-frame. We will not struggle to find a sceptical voice from within the sector and from current ships' pilots and so getting the right balance is very important.

Tentative thoughts and questions emerging from the plenary discussion at Lloyd's Register:

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Is there potential for technology transfer between the aviation (etc.) and the maritime industries?

Education and upskilling would be an excellent service design project.

A range of perspectives need to be taken into account.

Is there any low-hanging fruit to help develop trust and confidence?

The problem starts with touch and the use of materials and progresses through every level, up to and including whole system design.

What will the profession of a Ship's Pilot look like in the medium term?

Where does saving life begin and end?

What is the set of skills and knowledge a pilot needs today?

How can the industry ensure greater levels of investment in health and safety?

How do we intend to work with the various members of the stakeholder group?

Is it better to start out co-designing with key participants?

What learning and teaching methods do we wish to employ?

What learning and design outcomes do we wish to achieve?

There may be more questions than answers in four months.

Research Issues

Data on number of pilot ladder incidents in the UK, other countries, companies per year LRF?

Estimates on under reporting per year LRF?

Associated risk from late pilot transfer and early departure to ships running aground etc. LRF?

Figures for general transfer issues between ships etc. LRF/RCA

Find SBS ship transfer techniques LRF/RCA

Other extreme transfer techniques Fire Brigade, Climbing, Astronauts, Submarine, extreme sports, offshore oil rig safety (20 years ahead) etc, RCA

Find information on hoist, transfer basket, sea scape compensation platforms use and issues from other areas RCA

Visit the MPA Safety day via invite MK RCA

Design Brief Elements

Need to clearly specify what we are tacking and the nature of the risk

Who are our key stakeholders? What is the layer cake of risk ownership?

What is the best ladder possible?

Lloyd's 'best ever' safety ladder specification for the industry standard

Best 'cost no problem' method of transfer?

How can we apply digital sensing technology to forecast wave patterns

Can we look at new ship to ship physical relationships?

Needs more confidence in equipment that can come from other side of the world

Can pilots use their own equipment/ladder?

Can colours of old or worn equipment or bad rigging be made visible or change?

Blue sky thinking for human cannonball, catch nets etc.

Pilots prefer natural materials that have reliable wear and visual inspection possibilities.

Explore whole pilot ladder lifecycle scenarios

Design for grandfathering psychology (what would be cool for a ships pilot to be seen using?)

Designing for safe transfer in rougher seas would enhance ship safety and provide economic benefit

Shore to ship can be more dangerous than ship to ship duesto bigger movement.

Field notes from Lloyd's Register Innovation Centre meeting on 11.08.2016

The meeting was convened by Dr. Vanessa Forbes, from Lloyd's Register and Professor Ashley Hall, from the RCA. It included a range of highly experienced maritime industry experts and three members of the project team from the College. An audio recording of the meeting, taken by Chang Hee Lee, has been added to Dropbox. The following field notes include paraphrases and reflections that were taken during and immediately after the meeting by Robert Pulley (Dr. Laura Ferrarello, Chang Hee Lee and Professor Ashley Hall). A new set of questions may emerge from these notes and, in turn, this may inform further discussion. The process is designed to provide a starting point for further client meetings and student briefings.

Other attendees:

Richard Battley LRF

Alan Swinbank LRF Principal Surveyor S. UK

Chris Hoyle Portsmouth Pilotage ABP (Associated British Ports) & Marine Pilot Authority (MPA)

Capt. Andrew G. Moll MAIB Marine Accident Investigation Branch

Pippa Moody Navy Command Marine Services

Capt. Rakesh Pandit MCGA Marine and Coastguard Agency

Agenda:

Topic Led by Duration

Welcome – and Introduction to LRF Vanessa Forbes 5 mins

Introduction to Royal College of Art and this Grand Challenge Ashley Hall 15 mins

Defining the problem – size and context (craft, weather, locations etc) Ashley Hall 20 mins

Barriers to innovation – structured session Ashley Hall 25 mins

Innovation ideas Ashley Hall 20 mins

Wrap up and thank you Vanessa Forbes 5 mins

Quote: "Look at the changes that have taken place in the building industry, a difficult sector in which to implement change - this illustrates that change can be managed and does happen."

Comment: The project may benefit from a review of change theory and an inclusive method for engaging stakeholders. There were differences of attitude and opinion across the board during the meeting which made the experience very rich.

Other sectors including aviation, formula one, the fire service, and mountaineering were mentioned as areas for potential technology transfer. Areas within the sector of potential interest included the Navy (Special Boat Service?), off-shore wind generation, oil rigs, cruise ships, and the RNLI. Less obvious areas of potential value include circus performers, such as Cirque de Soleil, and other sports such as windsurfing and kite surfing.

Quote: "This industry is very much about 'Grandfathering' and as such is resistant to change."

Comment: Piloting is a tradition that has very

deep roots. There is no desire to see significant change in the design of ladders by Chris the Pilot or his colleagues. Our assumption was that the term 'Grandfathering' referred to the passing down of practice and custom through the generations. There is also a legal definition related to a "grandfather clause":

"An exception to a restriction that allows all those already doing something to continue doing it even if they would be stopped by the new restriction." Thus, "grandfathering" is allowing an existing operation or conduct to continue legally when a (similar) new operation or conduct would be illegal."

Quote: The wood and rope ladders, most commonly used in the UK, are preferred by most pilots. The detailed 'whipping' of the rope is important when it comes to the grip when climbing the ladder. I have tried climbing ladders made of plastic and nylon and these stretch and are less stable. Most Pilot ladders are not manufactured in the UK today and cost around £300 assembled and finished to appropriate international safety standards.

Comment: Subsequent discussion focused, for a short period of time, on what the international standards are and whether there is an industry sector list on which ladder performance is measured against key criteria – a kind of 'Which' report (potential information gathering and visual communication project?). The advice given was to talk to the manufacturers (add to this pilots). It was thought that ladders are invariably made in China or East Asia. The majority of the team were surprised at how little these vital pieces of kit cost (Possible 'Lloyd's Register Approved' ladder system that is a higher specification and quality?).

Further discussion between members of the team focused upon the tactile quality of materials and our tacit knowledge of materials such as wood, rope and the skilled craftwork. When the major risk relates to maintenance and repair of the rig by the crew on board a vessel, visual appearance of weathering and wearing is an indicator of the how seriously matters of safety are taken.

Quote: "In Japan, the pilot boat is very powerful and is driven, nose first, hard up against the hull of a ship. The idea is to 'force' the two vessels together."

Comment: Researching cultural conventions to establish safe practice would be a worthwhile exercise. What does 'bow to hull' contact look like in detail and is there a design opportunity here? Transferring such practice may be easier to propose than to see adopted. How to test new ideas and build a network of early adopters of improved practice is a critical part of developing an improved system. While this is common practice in other sectors, including aviation and Olympic sport, the maritime sector is not so closely regulated and compliance is difficult to monitor. This may be, in part, because of a relative lack of investment in the industry.

Quote: "I am not clear why the RCA have been invited to do this and I advise caution. Many 'new' ideas have been seen before. If there was an easy answer it would have already been found."

Comment: The question 'Why RCA?' did not arise again following Ashley's slide presentation which explained the history of the College, listed international organisations IDE has worked

with, and illustrated selected, recent case study examples of research work and graduate work.

The expert group were far more relaxed and open following Ashley's introduction. It was clear that there were unspoken issues between the professionals who had been invited to the meeting and the thrust of the project initiated by Lloyd's Register. It is difficult to know the main cause of this although concerns related to an unknown and uncertain future in a rapidly changing world of new communication and control technologies may be part of the reason.

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Comment: This question was asked by an expert (what is his role in the industry?). Discussion around this 'meta' issue focused upon the lack of investment relative to the aviation industry. There was also a sense that, as the maritime industry has been working effectively (?) for hundreds of years and the knowledge passed on from generation to generation has stood the test of time, why change anything? The industry is considered to be conservative by the consensus of expert opinion in attendance at the meeting. A high level of knowledge and skill is maintained, by committed professionals, through custom and practice. Nurturing trust is critical and may be difficult because change is inevitable. It may be difficult to build the necessary level of goodwill and to win the hearts and minds of all concerned. Managing client expectations while maintaining the preferences of stakeholders may be difficult when the client is looking for radical innovation. One way to avoid this may be to offer ideas that include incremental product development, improving services and systems in the short term and proposing more radical innovation for the longer term. It is worth reflecting upon the fact that it took five years for a safety poster to be adopted internationally (what is this poster and why did it take so long?).

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ACTIONS

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- Design for grandfathering psychology (what would be cool for a ships pilot to be seen using?)

- Designing for safe transfer in rougher seas would enhance ship safety and provide economic benefit

- Shore to ship can be more dangerous than ship to ship duesto bigger movements

RNLI Innovation Centre Meeting, 31st August 2016

To look at current risks and opps around river for all activities – rescue, prevention and funding and to project into future. One area that keeps jumping out from review is that the area between Tower and Gravesend where the growth will be huge. Instead of another station, how do we engineer and design a safe stretch of water from scratch. Which effects all the stakeholders... PLA, MCA, RNLI, Police, Ambulance, Fire Brigade.

PLA have a planning dept. and would need to meet their standards. Has enough been done about designing the front of the building and the river, pathways etc. for safety of people. Opportunity to review the current standards to design safety into them.

Saving lives and preventing serious incidents (collisions, transport of passengers, pleasure boats etc.)

Thames Strategic Review – to see how Thames will change and RCA will bring a more wide ranging perspective of ideas rather than a narrow view.

Workshops in London – Involved stakeholders on the River, TfL, Kingston, Clipper owners, some council reps.

Changing of the bureaucratic system in the next years...

Will the outcome be practical or more conceptual? We hope that they will be pragmatic and grounded in reality but with an idea of foretelling/future casting...a bit of imagination to adapt the ideas in the Thames review all within the remit of safety.

RNLI looking to review deaths on river from – half at least, ideally zero. Immediate need to reduce deaths on Thames as well as long term plan to deal with might happen in the future. Huge amount of data, so know the hotspots, suicide areas etc..

Risks and opps of today and the future...46% increase in incidents -20% around Tower, doubling at Gravesend and where nothing there will be huge increase.

Is there a pattern that can tell in the future there will be incidents – tourists, weather etc. Would need to speak to Green Street to get the info to know where the areas of danger and risks really are – young men at night under the influence are the biggest vulnerable group.

Responsibility for the river being unsafe lies with the boroughs – duty of care for residents and they need a safe open water policy. Actually (apart from Kingston) to see if they've done a risk assessment, have they got policy, education etc...

River safety forum – London Resilience Forum – needs to then populate down to boroughs so that it's part of the London Safety Plan. Not RNLI alone to do this.

Kingston is a bright spot – bouncers, fences etc. Result of a death, mother campaigned as her son fell in when drunk at an open pathway.

Knowledge of the river – if the Thames is more populated can the idea of the river change from the line that divides the city will people become more educated? Well, PLA wants to avoid the idea that the river is dangerous. Changing the perception of the river?

Design thinking applied to this – need

something physical to inspire them rather than preach. Also considering the fact that a lot of councils are under austerity they might not have the funds to do this.

Building a wall isn't always the answer, as this cuts people off and lose the knowledge of the river, so maybe redesigning etc? Developing common sense in people – water awareness.

Education is carried out by volunteers but led by education team. Focused on primary school age. Volunteers visit schools and youth groups. Education is primarily sea safety rather than tidal Thames. Also first year college postgraduate designers. 6 colleges, 1500 schools on the river.

We can attend the workshops – when the next one happens please let us know.

What is innovation to you ? Innovation is a small team that operates with the other depts. In RNLI, building an academic engagement strategy (how to go out and engage with uni's etc.); integral to our research that is external people – workshops and foresight work engaged academia and industry; analogous work that relates but we won't step on toes; looking to 10 years in the future; only 8 months old and trying to build the context and knowledge. Future tech platforms. Work internationally with Maritime Lifeboat Federation and how to share innovation challenges across the world. Innovation also looks at fundraising for future and fundraising pipeline and product development, whereas Tim's team is about future agenda.

This work could be the aspirational piece of work that will change the perspective of the river and support the plan of a safer London.

Something could influence the partners – one of the areas we are interested in tackling in terms of design thinking.

Work through volunteers and a range of people. Your role is admin, supplies etc. – how does this fit into the action of saving lives? RNLI formed as a response to local disasters, ad hoc funding, design, training etc. to provide standardisation and a national service with common levels of equipment and funding. Provide quality assurance, design and provision of equipment. Some people think RNLI is too centralised and the volunteers are being told what to do, so looking to devolve some powers in a research project – what do volunteers want devolved and what needs to be centralised.

As for the Thames, the community level wants to decide on where to focus based on their knowledge. Still need standards and assurances given by the centralised element. Each station is autonomous to an extent.

Ownership of stations – Tower is owned, the others are leased and two are cohabited.

New tech and isolation of each station – standard volunteer will visit the main centre 3 or 4 times. Good to get the views of other crews, but volunteer fatigue in bringing them in too often. Culture of RNLI depends on where you are. Online education removes some of this contact time, so looking at this impact.

Thames have a full time crew at the station.

Coastal – From being paged 10 mins to launch, half hour to anywhere in ten miles

Thames - From being paged 15 mins to incident. Full time, professional crew mostly. Volunteers 2 hours a week. Dynamic is different.

Can we meet a crew on the Thames? Yes!

Culture on the four lifeboat stations is kind of similar. They are looking to make a Thames crew rather than one for each station. One culture for the Thames – preference of the Thames operational culture. Full timers are moved about.

Prevention on the river – not joined up really. Not measured so hard to know if it has an impact. There is a community safety manager to try to develop preventative methods for a workshop. In London prevention is about supervision through CCTV, members of public, influencing to stop incidents. RISE model – Rescue // Influence// Supervise // Educate. Swiss cheese model all the holes align, then a death will occur.

"BREAKING THE DROWNING CHAIN"

150 drownings per year – halve that by 2020 odd. Rescue is pretty much as optimal as possible, so need to address the I S and E.

CCTV to predict people who will jump – TfL are looking at this.

Cruise Ships – people fall off and no-one knows. They have a system for detecting people falling – but this is just an idea, it involves the bridge owners etc. RNLI cannot do this alone.

Live data sources to be tapped into? Smart Coasts? Tapping into sensors, cameras etc. Thermal CCTV? RNLI is an asset deployed by coastguard, so anything like sensor systems etc would have to be put in by MCA as not really RNLI purview. Massive collectors of data, but mostly manual. IT dept is working on scouring Twitter for parties etc to have a lifeboat hanging about. NYE there are extra assets etc.

Stations know that there are tidal cut offs/ causeways etc. locally that will trap visitors – they can go and preposition the boat in case.

How much to launch the boat – practically, the cost is borne by volunteers being not at work. PR quote a cost of several thousand, but that is the cost of RNLI divided by total launches. Larger stations cost £250000 per year.

Deaths 6 – suicides – 20 per year.

Grandfathering – involvement in product development, product demonstrations, informal conversations. Kit demo day – we've used what we use for ever, but if demo and but try it out then more open. Electric outboards – advised no initially, but after discussion electric motor is perfect for lifeguards!

Pilot transfers at Port of London?

Station visits; data on Thames launches by different metrics; educational workshop materials; education workshop/event attendances. Tour date – either 1st or 2nd November.

360 video of a blast up the Thames – Google Cardboard.

Clipper up the Thames.

Visit to the PLA.

LRF Conference Call, 5th Sep 2016

Sanjivan and Ashley Hall had a conf call with the following from LRF: Richard Clegg, James Pomeroy, Vanessa Forbes and Tim Slingsby. This was at their request to give them an update on the project.

Ashley explained the two sub-projects: Pilot

Transfers and RNLI Future Thames.

Pilot Transfers will be narrow and deep. It will seek to present innovation solutions to problems of safety in this area. We expect very tangible outcomes (e.g. simulations, scale models for larger objects, full-size models for clothing, short films etc.).

RNLI will include the RCA as part of a team looking at safety on the Thames within a 1 mile stretch. It will look at a broad range of issues, is more strategic and therefore open-ended.

We agreed to draft and share problem statement/brief with LRF by mid-September. This will have been signed off by the project partners by then.

We have also applied to include the project within AcrossRCA. LRF were keen for this to happen and asked to be kept updated.

Richard asked what the outputs from this project might be. Ashley suggested they could include suggestions for improvements to existing technology or emergent/new technologies - perhaps transfers from other industries such as off-shore wind farms. These suggestions might take the form of computer simulations, short films, plans, drawings, scale models or full-size prototypes (e.g. wearable items).

The exhibition application was also discussed. LRF agreed that we could include costs for exhibition at the RCA, at RNLI Poole, and a prize fund. It should also include an event/reception for invited guests.

Tim requested a copy of Ashley's presentation to GTC and other guests visitors.

RNLI Meeting at Tower Station, 8th September 2016

Thames Operations Manager Neil Withers – Responsible for here to Canvey Island.

13 years with London Fire Brigade and moved into RNLI as volunteer and then got the manager's job

Very similar but working for charity gives more freedom than public service. If something on the river can get approval really quickly.

3 main harbour masters – Bob Moore, Catherine Spain (Deep End/Lower) Mark Tawains (sp?) (Shallow End/Upper)

Catherine already has had conversations about the pilot ladders and a few near misses over the last year or so.

Tim Johnson told us they may go out – launching now to Tower Bridge

Paraboard, rowing, Chiswick and sailing etc.

Here is more commercial and Gravesend – because of Port.

Security to some means counter terrorism, but we are more looking at deaths in water.

Thames Review – an aspect of counter terrorism – how to coordinate with services.

Not dealing with the sea, only the Tidal Thames. We are looking to develop the areas that the postgraduate designers will approach, so we are finding the issues to address now so your input is helpful. If you would like to come to the college to talk to the postgraduate designers it would be very useful.

The Thames Review is an integrated risk

management review for the Thames. Looked to last 15 years and forward 20 years so that we know the risks, the forums and how to move forward. Development of houses is huge – how do we influence the borough to put priority as part of the design. In Wandsworth they've made the seawall into a chair!

Designers and casual users don't understand the tides. Sit at Gabriel's Wharf, go left or right and get into trouble. Same with Boat Race – but the women's race changed the dynamic from a ten minute to a two hour slot, so more people on the foreshore so 20 rescues in 2015. This year 8 through messages/ life size inflatables of crew and boats etc.

London is bigger issue than the Thames only – Camber Sands drowning for example. How to engage with the people who are diving/sailing etc. when not at the coast so that they know what to do when going to the coast?

Can we arrange to attend the workshops and education events and can we get a pack of materials?

Non-uniform packs and info – can sometimes happen, but starting to get better. RNLI is making the decision to be proactive rather than reactive – so community engagement. Happening for years locally, now happening from a central position.

Thames has lead on a load of info and way of delivering info. All the risks are here apart from high seas.

Remote control life raft – EMILY! Lifeguards.

3 different classes - Teddington has the D class (2), here and Chiswick E class (2) and two spare old at Wapping, Gravesend B class.

Never run out of boats because of this. Special occasions they get brought out (NYE etc.) so there is communication between the stations.

Suicide is RNLI and Police and ambulance on the land, RNLI, police and fire on water. Good coordination between the services. Usually CCTV or someone will spot someone on the wrong side of the railings. People tend to call Police etc., not the coastguard.

AIS – automatic information system that transmits the boat ID etc.

Port of London – no boats move without them knowing. RNLI is a declared resource to the coastguard. If they get something they will call the RNLI – they share space/resources.

Roles of station

2 calls a day, so can't run conventional lifeboat volunteer station. 10 guys on 4 days, 4 nights, off. Each station has 50-60 volunteers – here for 12 hours. Station is an office for a manger and spaces for shifts etc. Training here, office etc. Off duty end to give resilience so that can get an extra crew if needed.

Public wants to come and see lifeboat station. But no visitor station, so as soon as the boat goes out no one to greet them. Terrorism – packing boats with explosives etc...That's why we keep it restricted. There is a visitor officer, but will escort them off the station too.

Tour talks about safety, boat launches, raising money etc. How knowledgeable are people in London of the RNLI? Not really. On the coast etc. well known, here only 30% know they operate on the river.

Thames community that live and work on the river and then the London community that is

everyone else where they think the river runs through. More people drown in the river than cyclists die.

Will increasing the knowledge lower the risk – yes, the Thames community but the larger community won't know and how does the RNLI engage with that community?

Canals are the Police and fire brigade because the RNLI doesn't carry that resource. Police have got them (boat behind Land rover etc.) Educationally they can engage but no other.

If able to buy a canal there is no info before you can take it onto the Thames, but if the RNLI engage before then it reduces risk. Collision Regulations – canal boats use the Thames but don't know the river or any other regulations so go through central arches etc.

Arches have lights, sides of the river for certain directions.

Risk to operatives - Local Authorities get hell-bent in red tape and procedure and became risk averse because of liabilities. Although Police in the river will sink with all of their gear. Also based on the person in the river – compliant or non-compliant. Some aggressive, knife wielding cases in the past. Now they are training for this situation – how to restrain etc.? What do you do in that situation? RNLI is looking to offer training on this and create a policy

Policy and training don't necessarily tally – if act outside the policy and this is challenged in court….people are scared to go outside of it.

RNLI isn't so proscriptive as it's a charity.

Signs on the Thames – are there any ways of telling people that the tides are low etc.? The local knowledge endorsement – any skipper needs to pass the exam which is a bit like the knowledge.

We're moving towards improving way finding for the river. Kingston Uni – mapping the Thames with GPS – an IPad that could bring up a photo at low tide to know the shores etc. In Venice there are piles of wood to show where to navigate in the lagoon, so create streets where you have to go. There are marker buoys in the Thames, the lights etc.

But this isn't known or readable by the public at all – even people who buy a boat and don't know the river or regulations. Duck boats are always getting rescued!

Mud and slime on concrete etc. People can slip and crack their heads.

Power to tell authorities? Yes, but up against human beings who want to do their own thing. Classic case at Sandbanks – told 5 times not to swim in that part of the sea and he still did about an hour later and got caught in the tidal current.

LFB all carry lifejackets etc. now. Primary inland resource is the LFB.

Questions

AIS Automatic id system – uses GPS to show the positions, name, photo, heading and speed of all the commercial ships

System in place for communication between the stakeholders – cascading of info? The person taking the call will deal with that and the core handler will make the decision. If the river Thames is mentioned then they will inform the coast guard. Police will inform the Marine Police Unit and then they will inform the RNLI.

Listen to the MPA radio and hear the call before the official call comes in. Free to intervene without the official call, but they will inform the coastguard to let everyone know. But no set way of doing it!

CAS CARE - Casualty care – slightly more enhanced than first aid – the kit and approach to how to deal with casualties. 6-10 Doctors and paramedics.

Chris – full time helm and CAS care trainer:

Check card system – crew does a 3 day training course. Take them from no knowledge to level of ambulance technician but the deep knowledge of anatomy etc. is taken away by the card system. As long as they use the cards nothing can go wrong. The cards are on the person at all times and provided by the RNLI. Big sick / little sick. BS time critical (heart attack etc.), LS non time critical (broken leg etc.) About to start writing the next iteration of the cards to fall in line with paramedics etc.

Even doctors and paramedics have to do the course. 8 casualty care trainers who train every volunteer across the country. Training and every three years refresher. Purely for RNLI but some outside agencies on rare occasions. If the card system could be taken up by other partners on the river, that would be great. But some don't follow the same protocols as their level of involvement in medicine is different and there are a range of governing bodies involved.

Community first responders might have different guidance, but the RNLI has better knowledge so trumps then and then the Ambulance has better knowledge and trumps RNLI. Down to litigation too as if the ambulance is there and the patient dies then there is a case for suing.

Any psychologists on the team to deal with suicides? No, but moving into that to prepare the crews for dealing with mental health issues – things to say, not to say, how to approach people. Now there are also 6 practitioners to deal with PTSD in the crews. Suicide prevention – working closely with CALM, MIND...to positively engage with this, much like Transport as this has reduced train suicides.

Bridge watch – volunteers trained only to deal with people preparing to jump while the boats are launched. Also beneficial to not be uniformed as lots of people have previous issues with the police and mental health.

Design of cards - initial one was done with thought bubbles, yellow vs. purple is only to separate the page but has no meaning. Red boxes are signs and symptoms if injury, follow yellow if illness or in the water follow purple. Following the book step by step and this will be enough to save people and within three days of training the responder will be able to save. Designed by Paul Savage, now outside of RNLI (still a volunteer) Saviour Medical Paul Savage OBE.

Casualty care manual – to remind volunteers of the processes taught at the three day course. One at every station, pdfs available etc.

UK Marine Pilots Association Conference, 15th September 2016

Conversation with Chris Hoyle

LRF have invited RCA to look at the "spate" of pilot ladder accidents.

Only 1 was due to equipment failure, the rest are due to human error.

You can refuse to use the ladder if it looks unreliable and can even go as far as cutting the ladder off to stop people using it in future. It's easier to tell from the top if the setup is right.

Arresting equipment (carabineers etc.) is not the best solution as it's another bit of equipment that you're relying on the crew to maintain.

Don't bother talking to the older pilots – they have no desire to change the industry and are wary of outsiders and think their views aren't needed.

To become a pilot you spend 8 years training to become a master mariner and then another 6 training to be a pilot. Well worth it as you get to pilot giant toys around!

Aviation Industry isn't the same as the Maritime industry.

Aviation has 2 main manufacturers, centralised, global standards and only a few different types of plane for functions.

Maritime has many manufacturers, many standards and associations and a huge amount of ships for different harbours, uses, situations, places etc.

Welcome to go on transfers in Southampton with him.

Conversation with Hwyel Pugh

Same opinion of LRF looking at pilot ladders and use of extra equipment.

In the 1970's there was a pilot ladder hoist system that was implemented but was dangerous. It kept failing due to a lack of maintenance, so pilots would end up halfway up and stranded. The sea conditions and the chemicals used to clean the deck are very aggressive so equipment tends to fail regularly unless well maintained as it's kept on the deck. The winch hoist systems are now banned.

Apparently there is nothing better than the traditional ropes used as the material has no spring back and doesn't fail so easily. Plastics and metals don't work as well.

Conference Proceedings

0915 – Cold water shock

Don't really like talking about it but near misses and events happen. Everyone always says that transfers have gone smoothly but looking back you can think that it was all a bit close.

Here to give you info to ask the right questions and make decisions rather than be proscriptive.

Problems– Not everyone knows what pilots do. Ship owners think they're money grabbing gangsters and port authorities think they're lazy.

The variations of factors involved is huge – then there are poor conditions, the size and type of ship, weather, if it's loaded or unloaded etc.

In 2006 there was a high number of deaths that finally made this situation unacceptable. Between 2005-2012 there were 20 deaths. It wasn't until 2012 that the A1045 doc of how to set up a pilot ladder properly was put into place and should be on the bridge of every ship. If the ladder does not match these standards then pilots are well within their rights to refuse to climb it.

Post SOLAS regs in 2013 there has only been one death but many more near misses.

Prof Mike Tipton, Portsmouth Uni on cold water immersion

This is an extreme situation in the cold and wet.

In the UK more children die of drowning that TB and other diseases. There is more death in the water in the UK than cyclists and from fires.

There are no lessons in the national curriculum about sea and water safety. We are only asking for one and being told no. So no one knows how to swim in a riptide – which the people at camber sands were affected by a month or so ago and contributed to their deaths,

There is a variation in the physiological response to cold water depending on age, sex, race, fitness etc.

Usually hypothermia isn't a factor, but in fact the cold shock response. This can start hyperventilation and gasping for breath, which means that people can inhale a huge amount of water in one go (1.5litres) and drown. The best thing to do is to calm down, float and catch your breath before trying to swim anywhere (and only use legs to swim so the arms don't lose heat.)

After 20 minutes in the water grip strength decreases by 50% and you are unable to oppose finger and thumb.

The characteristic or plastic changes in when cold and wet – it becomes incredibly slippery, so designers must consider this when developing products.

Papers – "Physiological pathways to drowning" & "Essentials of sea safety"

Matt Leat, HMCG Maritime Ops Controller

Majority of pilots wouldn't contact the coastguard (HMCG) if they fell overboard.

Local knowledge – coastguards have it but are using a system to put local names into their map so it is also shared. However longitude and latitude are best.

Aerial search and rescue has been taken over by the coastguard – RAF are no longer responsible. HMCG has 10 bases with 20 aircraft, the S92 and the AW189.

The fast ranger GPS personal location beacon information is now showing on the AIS system, so individual pilots can be seen on screen (if they are wearing them.)

Pilot boats act as the eyes and ears of the HMCG. In the room of 50-75 pilots 15 or so had never had medical training for an accident and only 3 had had training in the last year.

The crew of a boat can vary from 2-3 people.

The HMCG will ask 5 main questions if you call – who, what, when, where, weather.

UKMPA are increasing training for search and rescue and to have better communication with HMCG. This isn't to turn them into lifeboat men, but to give them the basics.

Amount of time to get the pilot from the water to the deck – one says 2/3 minutes, some say 30 minutes, most say 10-15minutes.

What is the medical intervention at that point?

Dr. Paul Savage OBE, RNLI volunteer

Why is casualty care so difficult in non-medical professions?

Head of Medicine for RNLI and developer of CasCareCards

Hypothermia isn't the main problem – in 2 degree Celcius water is takes 42 hours to get to hypothermic state, and waters around UK aren't that cold.

Most die of cold shock and drowning from gasping.

Only Southampton and Tees have a defibrillator on the boat – one pilot says he asks but the harbourmaster said that it would be affected by the vibrations on the boat from the engine so wouldn't work. Apparently this is true for older models and if lying on deck with engine on. If on blanket it shouldn't be a problem.

Only basic first aid courses are given – fine if an ambulance is 8 min away (like most of country) but not useful in this situation. 15-60 minutes to get back to shore!

Good CPR to restart the heart survival rates

Just CPR – 2% survival rate

CPR and defibrillator and oxygen – 10%

Good CPR and defibrillator and oxygen and medical back up – 30%

BUT CPR training is usually old – 3 here did it a year ago and the rest around four. Add to this being in a pressured environment instead of a carpet.

Cardiovascularly fit people are perfect for cold shock! Here are the examples:

1 Instant cardiac arrest - DEAD

2 Cold shock – breathe in 1.5 litres of seawater – DEAD

3 Water on face – cold shock plus autonomic response – DEAD

Most pilots say that once on the boat they would use a space blanket. Silver sheets make cold and wet people colder! Use a normal blanket.

Wind farms are much more regulated – a full time paramedic must be there. There is an urgent need for an updated first aid for pilots because it is need, not just to satisfy HSE regulations!

How about putting together a similar solution to the RNLI – Check cards to take away the memory test and training and equipment that is relevant to the situation. What good is knowing how to put an arm in a sling going to be in the situation?

There are only three harbour masters in attendance at the conference (all in the country were made aware and invited) Paul says – "That is how much they care about your safety."

Hydrostatic squeeze & horizontal/vertical removal from water

Pressure of water on legs to push blood to core – works to help you! But when removed from water head first and vertically this can cause the blood to drop to legs – low blood pressure – cardiac arrest – dead.

HOWEVER – only happens if lifting quickly out of water above 2m, if you've been in the water for 30minutes. Otherwise horizontal removal from the water isn't necessary.

Port of London Authority Meeting, 21st September 2016

Meeting with Cathryn Spain and other

harbourmaster. We briefly explained the project:

Pilot transfer – here to find solution to avoid risks and casualities in transfers.

Briefed to look for blue sky thinking, not just for the ladder but surround issues too.

Postgraduate designers will be involved.

Research is fed by postgraduate designers experience.

1st week – 30 student workshop to look at pilot transfers and RNLI.

RNLI – saving life now and Thames 2030.

Here to prepare topics and how the postgraduate designers will approach the area, understand the problems and specific issues involved.

Pilot Transfers

Student meeting on 2nd November – visit here to experience a pilot transfer?

Postgraduate designers might be best to watch from the harbour launch.

12 people ONLY per boat and pilot transfers can't be planned so much at this port, so might not happen while here.

Instead perhaps we could film a pilot transfer with a head mounted Go Pro for Google Cardboard to give them an idea of the way it feels. We could have 1 or 2 of us on a patrol launch for a couple of hours to try to do this.

2nd November visit – the PLA to give a presentation of pilot transfer arrangements and stepping on. Can also get a pilot to talk at the PLA.

Even if we can get the postgraduate designers on the boat it won't repeat the experience of pilots – they can easily spend a couple of hours on a boat in the winter at 2 am in driving rain!

We know what is supposed to happen in theory, but we want to hear anecdotes and info about how it really is.

Arrangements On Board Ships/Ladder Info/Pilot And Crew

Where is the ladder stored – on the deck, but moved around and tied down?

Can we go on board a ship?

The lifespan of a boat is 15-20 years- then it is refurbished and can sail for another 10/15years. A "modern" ship can be up to 20 years old.

Defect reports - Ladder rigging – ropes parted, wood broken, tied to rails and not the deck.

How to approach the problem – understand the complexity of things around it.

Ships can raise and lower in the water due to loading. Cruise ships tend to have a door but this doesn't work for cargo ships so well.

Cargo tends to change the draft of the ship so much that the door could end up 1-2m above sea level or below.

There is no standard pilot ship.

Accommodation ladders are complex as they have to rigged in a particular way.

There are no fitness requirements for pilots.

There are controls and standards and they are applied, but they vary depending on where the ship is registered. Many sail under flags of convenience so they can get away with doing less.

The crew/captain/ship can be arrested/held if not up to standard. This would be by the UK Maritime and Coastguard Authority (UKMCA.)

If there is a ladder failure the pilot would report it to the PLA, who report on to the UKMCA, who will then do a thorough inspection of the whole vessel. So it makes sense to have a good ladder.

The ships are internationally registered, so if there is an issue it can be reported to the next destination so that harbour can investigate too.

Is there a database of pilot transfers? No, but the most common failure is how the ladder is rigged or the maintenance of the ladder – frayed ropes, chucks missing or broken etc.

UKMCA investigates incidents. If they happen the UKMCA and the port will investigate as it affects a member of their staff directly.

Is there a way of tracing why the ladder has become so damaged? Weather and sun damage. A particular area of the ladder can get damaged (i.e. rope over the deck lip). The natural fibre changes colour from sun damage.

The pilot can report if the ladder is stored incorrectly.

The port authority can refuse to put a pilot on board if they are worried and a pilot can refuse to get on if they are unhappy.

But realistically! The ladder has been used at previous ports so it'll be ok.

The ladder is big and heavy! 3 or 4m long and needs 2 people to carry.

The captain of the vessel is ultimately responsible for the ladder. He will delegate someone to check it. The crew will do eyeball checks to see if it's ok.

Ladders used to be made on board through handed on craft skills. This is less prevalent now as there are less crew/time/experience to do this. This means that running repairs are less common. Instead ships tend to carry spare ladders.

It is more important to understand the ships capabilities than how the ladder is made.

The most critical element is stepping from the boat to the ladder and back. The pilot will clip himself to the pilot boat railing and unclip to climb. They will also walk the long way around the boat to get to the ladder as if they fall in they avoid being crushed between the two ships.

Less skills and fewer people. A small coaster has 6 crew so that costs will be lower – no one spare to do anything.

Ships have machinery problems and defects and again due to less crew and maintenance as there is little to no down time as it is always running.

Training in seamanship isn't equal between countries as the standards can be very different. Insurance is lower for "first world" countries and higher (or maybe not even given) to crews from "third world" countries.

Securing a pilot ladder is basic training and one of the first things taught to you as a cadet in the UK. Most ships will have a crew for a certain area – for example Filipino deck crew (not officers.) Filipino crew are pretty reliable and can be trusted on the whole.

In the past there would always be an officer to greet the pilot at the gangway and to check the rigging of the ladder. Now this will be done by a

crew member.

For the visit – Presentation, casual, conversational, pictures and video. Pictures of failure of ladders and boats.

Experience – Could split the group, so 15 here and 15 out on the port and then swap. How much time to give? ½ a day for each cohort. If we can go on the Estuary transfer that might be better as the waters are rougher.

Appendix 4: Global Pilot Survey

Feedback Comments on Safety Grand Challenge

Contents

A Marine, UK

There were some interesting pieces of product design here. The bulwark clamp arrangement and the high-visibility ladders could provide some benefits. The "build-your-own" modular ladder would be subject to a number of design flaws – not least the ability to reuse following general contact with the saline marine environment. In addition, the app could provide some value but generally pilots just refuse a boarding if the ladder is in a poor condition – and would report it to the harbour master or port state control who would subsequently inspect the ship – leading to a corrective or punitive measure.

To my mind this was where I was a little disappointed – in that I was expecting something really innovative when I originally saw the project announced several months ago – and was quite looking forward to the result; but I found the main problem hasn't been even looked at i.e. What is the safest way to get a person some 10-20 meters below on a smaller boat up on to the deck of a ship – usually when there is large relative motion between the two? The ladders themselves are generally not the problem.

B Marine, UK

I strongly believe the best available mitigation of the risks incurred in this practice are currently operational limitations. I address below what I believe is the single biggest risk involved – transferring at night.

There are a number of factors involved in safe transfer, including sea state weather wind, skill, experience and fitness of the transferee, safe well maintained equipment etc. etc. If there are waves present a limit on the wave height can be imposed. However what is usually forgotten is the increased risk when it is dark.

When transferring you are meant to judge the waves so that you transfer when the pilot boat is sitting at the peak of a wave. During the day with clear skies, this is not too bad to judge if you have experience. But at night you rely on the surrounding sea to be well let.

I have never seen a ship yet where the surrounding sea can be lit well enough for one to be able to correctly judge the waves. Probably the next biggest risk is the state of the pilot ladder. Unfortunately for surveyors and pilots alike they only find out the actual condition once they have transferred from the pilot boat. Some organisations e.g. UK Maritime and Coastguard Agency, have a policy which states that their surveyors will simply not transfer at night.

C Marine, UK

I looked at the pilot ladders in Fenchurch street a while back, my mind is a little fuzzy since then. Generally they were good ideas, the cross lock system was good for identifying if the system was not set-up.
I spoke to the students there, one of the systems had reflective tape on, which whilst good from a distance, when climbing with a head torch would be blinding (a illuminous band could be a good alternative).
One of the key issues was the resistance of the material to sun and salt water which I did not see much appreciation of.
It would be good if there was another project on the 'platform' from which the person steps onto to pilot ladder as this interface is the most dangerous. Pilot boats have standards and are generally ok, a stable platform with handrails to hold onto both sides before stepping onto the ladder.
We embark on a lot of vessels from non-pilot boats.

D Marine, Brazil

The projects Cross Lock System, Sea Pilot Transfer and Expressive Ladder (mainly the expressive ladder) seems to improve the ladders quality and visibility (mainly expressive ladder), which may help.
This is important, but, in my point of view, far to be the change to relevantly reduce the risk.
Otherwise, although I have liked the expressive ladder, it seems is better you have always the single vertical rope or two ropes firmly connected.
It seems the dynaweb project is not good.
The ladder flexibility, in my point of view, is not against us. Depending on movements the ladder flexibility help us to catch the vertical rope.
I took the opportunity to reflect a little about the subject and from a risk assessment point of view, it seems we could not reduce the severity but maybe we could reduce the possibility (and consequently the risk) by promoting a concentrated campaign (maybe involving IACS) to encourage Owners to plan better the attendance requesting, by using the windows, looking forward to increase number of attendance with vessel berthed or in sheltered anchorages.
By reducing the quantity of attendance at unprotected anchorages we will reduce the possibility and consequently the risk.
We could further, through IACS, involve the Flag Administrations to provide additional power for the initiative.

Number of incidents during boarding operations (any ... Surveyors, Crew etc.) might help to build a clear scenario and support additional requirements.
In the concentrated campaign we could also include clear requirements to ensure that cargo vessels when possible will heave up the anchor to make an adequate lee. This is an additional manoeuvre but required for safety reasons. Again in my point of view the lee is not properly made with vessel anchored.
We may also consider creating an objective: to control and reduce the number of attendance at unprotected anchorages through a new key performance indicator.

E Energy, Houston

I have had an opportunity to review the video on Safety by Design – Boat Transfers and the 4 projects pertaining to the innovative ideas on Pilot Ladders. These are all good ideas and I can see that a lot of thought has gone into these projects, each is unique and has identified a specific improvement to the current system in use. If I were to have to choose a favorite it would be the DYNAWEB design as it seems addresses the issue of excessive movement.
I have a comment to feed back to the teams involved in this exercise based on personal experience and also the data available on Pilot Ladder incidents. Although the percentage of fall incidents from pilot ladders vary, depending on the source, we can all agree that fall incidents are the leading cause of injury and/or fatalities by a significant margin. I would challenge the teams and the industry as a whole to look at this from a slightly different perspective whereas they could incorporate a "Fall Arresting Device" into either the ladder design or at a minimum, in the process of boarding the Pilot. We are surrounded by fall protection requirements, guidelines and fall protection technology, I believe that we would be remiss by not, at least, entertaining this concept as we move forward.
I hope that I have provide some useful feedback to this project, I am pleased to see our organization engaged in these type of initiatives and am available at any time for feedback and support.

F Marine, Spain

All projects seems to have some improvement to the quality of the ladders. But according with my experience as Existing Ship Surveyor in a port where most of the attendance is carried out at the anchorage, they are not facing the core problem of the embarkation risk. In my opinion this is the relative movement between the boat and the vessel. The boat manoeuvring capabilities, crew training, heading inertia, and clear embarkation areas properly designed, are critical for a safe boarding. Of course better ladders will improve a bit the safety, but while unstable service boat are jumping and hitting them

the net improvement to the operation will be limited.

G Marine, Greece

Very interesting initiative , promoting innovation , cooperation of LR with the industry , and raising awareness on Safety.
All 4 design ideas introduce interesting views on measures for improvement of boat transfers and would be worth developing at a next more detailed stage .
Whilst the material presented is still at an initial stage , it introduces some practical solutions that could either stand alone or in combination contribute to an improvement of the safety during operations .

I believe next step could be to move to a prototype production stage, where these ideas should be tested in real time situations / conditions and where all stakeholders (surveyors , pilots , ships operators) could add their views and proposals.

H Marine, Singapore

Cross Lock System

With the cross bars a simple communication piece, which is so easy to understand. Minimizing the issue of human errors is very important attribute to this design. Not too much maintenance required.

Sea Pilots Assistant

Not my favourite. Too much focusing on an App, which in the rough working area might be not so helpful. Do not prefer the easy to maintain (replacement of parts) since the crews are not experts in this and the repair of safety equipment should be left to the manufacturers or similar.

Expressive Ladder

Great about this design is that the feel and touch of a pilot ladder is still there. This is very important, since many people are used to the traditional pilot ladders, which help safety

Dynaweb

Since been on those ladders myself in the (long time ago) past, the most difficult thing is keeping your balance during the movement and with this more ridged design there is much more stability.

I Energy, Korea

Cross Lock System

Positives

•Reliable system – if well controlled.
•Overcomes potential communication barrier between pilot boat and ship.
•Owners will not have to replace their existing ladders.

Negatives

•Lock out tag out system may be required to prevent unauthorised personnel changing the position.
•May not be much visibility from the bottom of the ladder if the poles are vertical.
•Does not address the risks faced when

actually using the ladder.

Areas of improvement

•Poles horizontal to the sea when rigged, so that they are easily seen.
•A lighting system could be utilised also – green light go, red light stop.
•Are the poles secure when in the upright position? When personnel get to the top of the ladder they will instinctively grab the poles to assist. Are they secure enough for this purpose?
•Address the physical connection to the ship / rigging.

Sea Pilots Assistant

Positive

•High quality materials.
•If used correctly, ladder will be well maintained at all times.
•Stable and secure – will minimise lateral movement.
•Due to modular design the length could be tailored to each ship and transferred from ship to ship.

Negative

•In practise this will be expensive for owners.
•There seems to be many joints, which are all potential areas of weakness or failure. The fact that the ladder is more stable will minimise movement but in turn create more stress at these joints – more detailed inspection routine will be required by trained personnel.
•Does not address communication barrier between pilot boat and ship.

Areas of improvement

•Seek to minimise number of joints
•Groves built into ladder steps to improve grip (similar to expressive ladder)
•Address the physical connection to the ship / rigging.

Expressive Ladder

Positive

•Good size steps with grooves built in to improve grip.
•Visual aids of steps will assist in poor lighting conditions.
•Use of spacers, keeping the ladder slightly off the ship for ease of use.

Negative

•Reflectors could cause glare.

Areas of improvement

•Address the physical connection to the ship / rigging.
•A lighting system could be utilised also – green light go, red light stop.

Dynaweb

Positive

•Stable ladder addressing the practical risks of transfers – lateral movement.
•Easy to use and retract

Negative

•Probably more expensive in practise than conventional ladders.
•Defect identification training will be required.
•Use of rubber parts – risk of wearing and degrading of rubber.
•Ladder steps do not seem to have good grip – plastics?

Areas of improvement
•Utilisation of wooden steps with grooves to improve grip
•Address the physical connection to the ship / rigging.

J Marine, UK

Being an ex-seafarer from many decades ago I recall joining and leaving ship this way as a sobering experience, 10m of vertical steel, with rungs 3inches deep is sobering - even though I was young and thought myself bullet proof at the time!
Of the 4 designs illustrated, the expressive is by far the best:
•Anti slip rungs
•A decent size of uprights (rope) to get hold of – a smaller or larger rope makes it much harder
The use of timber – very nice tactile material, but maintenance & hence structural reliability of timber treads is debatable.
The diameter of the rope used to hold on to – too small or large is hopeless.
The dynaweb example – in the GTC most people have commented on the use of jubilee clips to tie the two ropes together either side of the step, even though (no doubt?) only illustrative, it does not portray any positive points about it. You simply focus on getting cut by the jubilee clips.
The collapsible ladder – the video is not working, and you simply have no idea how it is meant to operate, other than being some concertina type of arrangements.

K Marine, Australia

Cross Lock System

-Not clear how the cross bars will actually work or operate.
-Normally, with good pilots and their assistants on board, the pilot ladder is always tested out prior to the pilot stepping on board. This is done by the assistant crew member placing his entire weight onto the ladder and moving it around to ensure it is secured & rigged properly.
-How will it be fitted to the existing arrangement? Ships have numerous configurations and this Cross Lock system will need to be compatible with all or the most used types.
-It states that when the stanchions are crossed, the pilot will be able to see this. What about in inclement weather? Will it still be visible?

SPA

-This item is good in regards to the maintenance of the pilot ladder only.
-In regards to the app, provided the vessel is in wifi or mobile range, it will be used.
-If the weather is inclement, I doubt the pilot will be taking pictures of the pilot ladder.
-The rating is ok but can be done after the transfer. A good idea however with so many ships entering the ports, this will only apply and work if the same vessels come back to the same port with the same pilots boarding the vessels.

-This idea was also completed with launch boats in Fujairah, U.A.E, where surveyors rated the launch / service boats. This helped as when clients arranged agents and launch / service boats, the surveyors would know it the launch / service boats were acceptable or not and the client could be advised accordingly.

Expressive Ladder

-Visual cues is a good idea and would assistance when climbing up/down ladders, particularly in the dark.
-It was stated lighter and better materials would be used. This would need to be specified. As it will need to be Type Approved and suitable for marine environment.
-More information and photos are needed as not really clear what the product actually is.

Dynaweb

-Video: Not really clear on how it works and what it does. More information would be needed. The video did show and state it was one piece. Storage and space on board would need to be taken into consideration, in particular, how to maintain it and replace parts if and when needed.
-The video also states that this was designed to minimise the side-to-side movement. This only happens when there are waves or the boat is pushing/pulling on the lower rungs of the ladder.
-Does not really explain what the product will look like and how it will reduce the side-to-side movements. More photos are recommended.

L Marine, UK

I think the students have looked at the safety aspect of the design but not necessarily looked at how this could be done differently. The most dangerous part of boat transfer as you know is the movement from the launch to the ladder and the first 2-3meters up the ladder to avoid contact with the launch. Also the decent back onto the launch which I do not believe is covered (ie we have recreated a pilot ladder design).

For Dynaweb my biggest concern is Dyneema rope is great in tension but I have seen multiple failings as the fibres are susceptible to being cut. So if the ladder is not stowed correctly this could happen from being caught on structure or being stood on. I have seen this in the yachting industry and it is recommended to be replaced around every 18 months. Also with the plastic cover you cannot see the condition.

The cross lock idea is good to simplify rigging arrangements and may be worth exploring more.

I don't understand the modular system and it looked quite flimsy.

The Visual clues on the ladder I believe is a great idea it would certainly help.

As I stated at the start if we want to look at this more radically we should look at air curtain systems which are wave disrupters to make the transfer from the launch to the vessel easier.

M Marine, UK

SPA

•The side rope diameter is too small to permit an effective grip.
•The yellow sleeve fitted to the side rope is good for enhancing visibility however the sleeve material is thin and travels down the side rope when gripped. The fitting of a sleeve may also hide damage or degradation of the side rope.
•The step connection to the side ropes allows the step to rotate excessively.
•The step has no non slip surface.

Dynaweb

•The rigid construction of the ladder feels very stable however it is not clear how this form of construction would be stowed on board ship.
•The sleeve fitted to the side rope may hide damage or degradation of the rope. Grip would need to be confirmed when wet.
•Colour of the pilot ladder is good.
•The attachment of the step to rope could interfere with grip.
•Step construction needs to be more substantial. It is doubtful that the display model would support weight.
•Non slip step covering is good.

Expressive Ladder

•Step colour is good however the construction of the step is too light. Display model showing signs of damage.
•The dual side rope construction with jubilee clips is unsuitable for the marine environment and grip.

Cross Lock System

•The purpose of the equipment is not entirely clear however the construction is not considered to be sufficiently robust for use in securing a pilot ladder or for use as hand hold stanchions. As a purely visual aid the equipment may be able to indicate whether the pilot ladder is ready for use or not.
•The feedback is intended to be constructive, and I would be happy to correspond with any of the students if they would like to discuss.

N HSES/Marine, Greece

I would vote for the projects as below: Cross Lock and Dynaweb projects looks the most interesting
The other two I think they are lucking some clarity, the descriptions are rather generic
In terms of the ideas strong points to be considered:

Cross Lock System

Human error approach – visually

communication - easy and cost effective
-lack of maintenance make all device inoperable

Dynaweb
New materials - lighter and stronger
Negative points or not captured : The projects focused mainly on those having the transfers however also the safety of those involved in the deployment (crew) should be considered, as we have seen many fatal incidents to occur when ladders are deployed.

O Marine, Israel
Yes.... There are some new good features almost in any of the proposed designs.
The key element for success here are:

1. Cost
2. Availability
3. Ease of fitting, maintenance and use
4. Enforcement to use a new design
5. Cost (yes...again)

With regards to a phone application....
Common.... Really? I am going to climb from a boat to a ship (done that a Gazillion times), why should I stop everything and look for answers in my cell phone? The answers should have been there already, in the ladder, material, procedures and training received before I even placed a foot on the boat.

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