Funded by UK Government

Transport Research and Innovation Grants (TRIG) 2022

Cohort Project Outcomes

Delivered by

CATAPULT Connected Places

Contents

Department for Transport

Foreword

The transport sector faces significant challenge and opportunities as it transforms its vehicles, fuels and systems. The impetus provided by the net zero 2050 target, combined with the rapid developments in technologies, provides a ripe setting for the transport innovation ecosystem. The formation of the Department of Science, Innovation and Technology in early 2022 highlighted the importance of innovation to delivering the wider goals of the UK. In DfT, the Transport Research and Innovation Grants (TRIG) provide a key mechanism to seed the transport innovation ecosystem with new ideas and new leaders, support economic prosperity and further the development of the transport system. The TRIG programme provides many small grants to innovators to address the challenges and respond to the opportunities of our transport system today. The use of a large scale programme enables us to support a broad portfolio of projects and help innovators take sensible risks – ones which they could not afford to take on their own. This is an important role for Government and ensures that we have a healthy pipeline of new solutions.

2022's TRIG Competition is the largest DfT has funded and now takes TRIG past 350 grants offered since 2014. It has been my great pleasure to see this programme grow, to get a chance to meet some of the exciting innovators who TRIG supports and to see how they are working to bring beneficial novel technology ideas to life. This competition has encompassed projects across the whole breadth of the technology and application spectra in transport and projects were delivered by innovators from across the whole United Kingdom: from Devon to Dundee; from Bournemouth to Birkenhead; and from Salisbury to Sunderland. This cohort also enjoys great levels of diversity, with growing numbers of under-represented groups represented amongst our innovation teams.

At a recent Innovation Panel event hosted by our colleagues at the Connected Places Catapult, I was delighted to present the TRIG Chief Scientific Adviser Awards to some inspirational projects from the TRIG 2022 cohort and would like to again to highlight these inspirational teams: DBR & Associates; Lancaster University; TaiSan Motors; VESOS Solutions; and Edge Innovation. I am very much looking forward to seeing how each of these 67 projects grow and mature over the coming months and am delighted to see TRIG continuing to forge ahead as a flagship support mechanism within the transport ecosystem for SMEs and University teams.

Congratulations again to all of our 2022 projects! I look forward to seeing your teams and your projects flourish and deliver vibrant innovation in all parts of the transport system.

Professor Sarah Sharples
Chief Scientific Adviser at Department for Transport

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Open Call

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CCI AssetScan™

Open Call

CC Informatics Ltd

AssetScan™ is an existing AI technology, developed by CCI, that can be used to automatically locate and track defects in large image databases taken from large infrastructure.

AssetScan™ has already been trained to handle dressed masonry for dams and reservoirs applications, and concrete for the Nuclear sector. The purpose of the TRIG grant is to demonstrate the feasibility for application on transport infrastructure - in particular, aging brickwork structures.

Project Achievements

- The further development of a survey vehicle to collect high resolution survey data in tunnels.
- The production of detailed 3D models of assets using photographic data collected.
- The processing of photographic data using AI to identify issues in brickwork.
- Updated algorithm to display photographic data and AI results on 2D engineering drawings.

Conclusions

The project demonstrates conclusively that AssetScan™ can be used in the context of transport infrastructure, particularly assets where the structural fabric is brickwork. AssetScan™ could therefore be used in combination with asset owner data collection programmes to automatically highlight defects and bring these to the attention of engineers quickly. With the demonstrated orthorectification techniques, this could be undertaken on a regular basis and used for automated change detection.

Next Steps and Future Measures of Success

Next Steps

- CCI will seek early adopters in the transport sector.
- Split funded commercial projects and additional grant funding for development.
- Further data science and product development towards TRL6.
- Development of outputs towards a BIM environment.

Future Measures of Success

- Additional data introduced into training datasets with manual labels.
- Validation on a project-by-project basis increasing to 95% accuracy.
- Commercial growth of CCI including procurement of additional staff.
- Acquisition of new commercial clients in the transport sector

Open Call

Esitu Solutions

Project Summary

The project addressed the issue of road safety for ambulance drivers who face heightened risks during blue-light driving. The introduction of Section 19 presents an avenue for specialised training, requiring that current ambulance drivers complete 8 hours of refresher training every five years, offering the flexibility of online or classroom learning. However, emergency services encounter resource limitations, potentially constraining their ability to develop comprehensive training programs. Over 30 hours of footage were captured from ambulances on blue-light runs around the East Midlands. From the footage we created novel and engaging hazard assessment clips and initial training videos. The assessment materials were tested on ambulance drivers. It received positive driver feedback, though future iterations of the test are required.

Project Achievements

- The project involved an intensive filming schedule where we filmed over 30 hours of footage from an ambulance on blue-light runs across the East Midlands.
- The resultant footage was synchronised and edited into edited into a bespoke graphic overlay of a Fiat Ducatto.
- The footage was then reviewed by our team of Traffic and Transport Psychologists to identify the most suitable footage.
- A focus group of 9 experienced EMAS ambulance drivers then reviewed the footage. This guided the editing and selection of the final 25 clips.
- We evaluated the assessment using 25 novice and 13 experienced ambulance drivers.
- We also created a series of short training videos. EMAS' head driver trainer provided an expert commentary for each video and key points of interest were highlighted to improve driver awareness of the vital clues when watching the videos.

Conclusions

Overall, the project received positive engagement and favourable feedback from EMAS and their drivers. From the data, we identified key characteristics of effective hazard assessment clips that can differentiate safe from less-safe ambulance drivers and produced initial training videos. The less successful clips offered valuable insights for improvement, especially regarding cut-points and driver options. It is, however, apparent that further iterations are needed to fine-tune the content before it can be deployed for commercial ambulance driver assessments.

Next Steps and Future Measures of Success

- The encouraging feedback from EMAS and our strong collaborative partnership with them provides justification to preserve with further development of the materials.
- Together with EMAS, we intend to submit a proposal for the Road Safety Trust's open call, which has a maximum funding limit of £500k.
- A successful grant would enable us to take our next steps towards further development. This includes creating additional clips, developing new video-based assessments beyond hazard prediction, and conducting further iterations of the edit-test-edit cycle involving a larger cohort of drivers. Grant success is never guaranteed and so we will also work with clients who are willing assist us in the evolution of our products.
- The TRIG programme has allowed us as a company to strengthen our relationship with EMAS, making future collaborations with them possible.

FORZUNA

Open Call

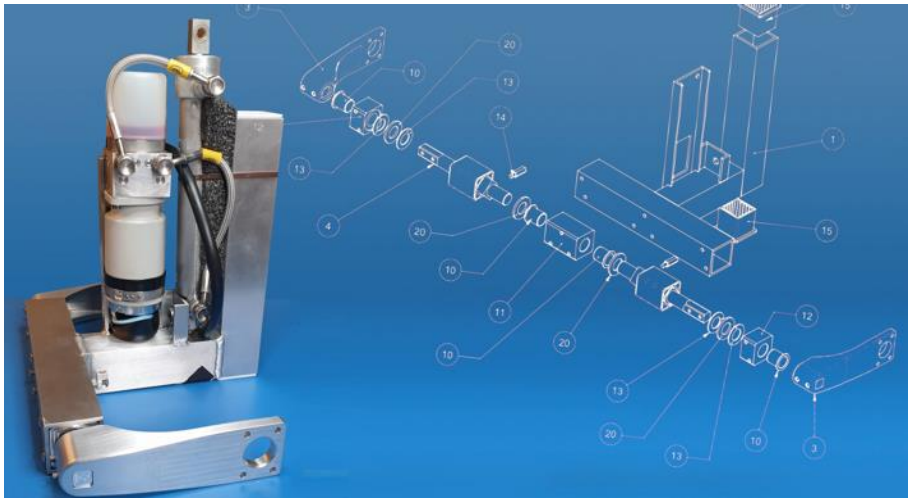
Forzuna

Project Summary

Our project aim is to bring a new format of personal-mobility to market, one that is designed from a 'safety-to-others' perspective, rather than the myopic 'transport a person' methodology. We re-imagined the agile, compact 'Segway' style of two-wheeled self-balancing format, creating a new, seated version that is actually safe and feasible to use.

We're developing a Dynamic Stability Control system which combines sensor feedback from suspension-loading and 6-axis accelerometer to enable inexperienced, infirm, or low-skilled/exuberant users to ride within safe limits.

Attenuating speed and direction-change of vehicle-dynamics, while riding in a busy, public space, keeping to socially-accepted norms.



Project Achievements

Project focus
We focused on constructing a very light, but rigid suspension system that holds two precise magnetic sensors that monitor the relative positions of the left and right suspension arms. This required high tolerances, to not allow any torsional flex, keeping the sensor-readings smooth enough to interpret at a high bitrate/frequency.

Main achievements
We designed a suspension axle/bearing/arm and sensor-mount assembly which required minimal custom-engineered parts. This came-in on-budget and schedule, despite having a large number of small precision-machined parts from several different suppliers.

Highlights
The assembly fitted-together perfectly, and is extremely stable/smooth to operate (easy to dismantle/reassemble with different stiffness of suspension/damping). The electronics-engineering was bench-tested while the machining/fabrication work was managed, this test-work translated easily to the finished components.

Conclusions

This is the second grant-funded module of our vehicle project, we're happy to say that the team's experience in project-management, and the professionalism of our subcontractors are working very well so-far.

The outputs show the Dynamic-Stability-Control is a viable addition to this convenient vehicle's feature-set, making, what was a very unpredictably-behaved (Segway) motion-algorithm, into something which can be

rolled-out to wide consumer-market.

There is still work to be done, tuning the DSC to the traction and torque delivery of the hub-motors, we hope to make 'safety level' a preference-adjustable feature for the rider to adjust to suit their requirements.

Next Steps and Future Measures of Success

The TRIG programme module has been an immense benefit to the vehicle project. The stability and safety of the self-balance platform was the only thing keeping it from being the huge commercial success, and benefit to zero-emissions travel, that the original investors in Segway Inc, hoped it would be. We're now able to add a new level of Accessibility to this agile transport-format, while keeping it affordable.
We're still trying for a Smart-Grant to fund the ultra-efficient new motors, that would enable this vehicle and its cargo-carrying variant, to be used in many more industry-sectors. We hope that the UKRI 'Design Foundations' grant will enable us to publicly test the vehicle with a wider audience (while protecting the IP best as we can), to prove its Mk1 prototype's initial popularity translates to many other demographics and use-cases. The multi-£Bn FarEast, last-mile-delivery market needs to be exploited while we have 1st-to-market advantage.

Open Call

General Noise Ltd

Project Summary

Loud vehicles are harmful, illegal and annoying – but tough to prosecute.

This project successfully developed a radar-based system for vehicle noise measurement, achieving 2dB accuracy compared to traditional microphones. A key advantage is its ability to attribute noise to specific vehicles, removing the ambiguity often found in microphone-based methods.

Future steps include radar upgrades and regulatory framework establishment. The technology shows great promise for accurate, cost-effective, and unambiguous noise enforcement, potentially revolutionizing vehicle noise management globally.

Project Achievements

General Noise Ltd's radar-based noise detection system offers robust legal validity by directly attributing noise to individual vehicles. Developed in collaboration with radar manufacturer Anteral, the prototype is not only cost-effective—with component cost <£700 —but also portable, weighing just 700g and operable via iPad. Unlike expensive, complex microphone arrays that provide probabilistic targeting, this radar system offers precise targeting. The project also discovered optimal radar frequencies to avoid interference from extraneous vehicle radars

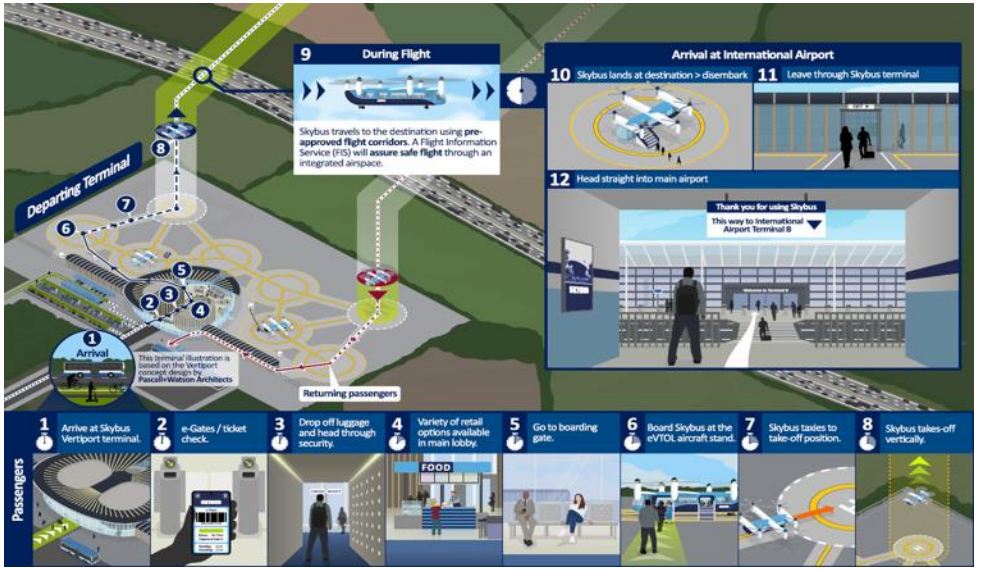
Conclusions

Radar promises a legally sound and widely deployable method for enforcing noise regulations, especially against modified cars and motorcycles. Our project successfully demonstrated a proof-of-concept noise radar for enforcing vehicle noise limits. Developed in collaboration with Anteral, the radar overcame key technical challenges and validated its capabilities in a real-world setting, advancing its technology readiness level. Although the prototype has some limitations, like restricted sampling rates and power output, it showed promise in overcoming drawbacks of existing noise cameras. The project identified next steps, such as improving radar power and integrating ANPR. We emphasise the broader societal benefits of noise reduction for public health and quality of life.

Next Steps and Future Measures of Success

The project's next steps for commercialization involve securing policy clarification from the DfT and obtaining grant funding for further live trials, particularly for developing a higher-power 60 GHz radar. Collaboration with ANPR or speed camera manufacturers is also crucial for technology integration. While there are provisional interests from manufacturers, formal collaborations await policy clarity. Being part of the TRIG programme has been a boon, providing essential de-risking and converting what started as a garage project into a technology with global potential.

GKN Aerospace



Project Summary

Advanced Air Mobility presents an opportunity to revolutionise public transportation, offering significant travel-time savings with improved connectivity through a new mode of affordable, accessible and sustainable transportation.

This project explored the potential of scaling AAM services in the UK based on the GKN Aerospace Skybus concept, a 30 seat eVTOL aircraft, especially for airport shuttle routes in major urban areas.

Project Achievements

GKN Aerospace collaborated with the Department for Transport, Connected Places Catapult, Frazer-Nash Consultancy, Pascall+Watson and urban-Air Port to carry out operational analyses on airport shuttle routes in the UK using Manchester airport as a use case.

Time savings of up to 50 minutes compared to driving for trips from around Manchester and surrounding areas such as Preston, Blackburn and Huddersfield to Manchester Airport were demonstrated at £30 Skybus ticket prices.

Conclusions

The project concluded that significant opportunities existed for reduced travel times on airport shuttle routes in the UK through the introduction of large eVTOL based AAM services. These services would benefit thousands of passengers at each major airport annually through a new sustainable and scalable transport system.

Next Steps and Future Measures of Success

Air taxis and Skybus could share the skies in the future, providing significant socioeconomic benefits to the UK through time savings, improved connectivity and reduced congestion on surface transport modes.

Collaboration between technology developers, transport authorities, airport operators, local councils and airlines is recommended to overcome operational and infrastructure barriers to initial AAM operations in the UK.

Greenway Innovations

Project Summary

The SmarTrax project aim was to further develop and validate a cost-effective, autonomously monitored rail slab for light rail vehicles, ensuring reliability, efficient maintenance and increased safety.

To achieve this goal, a combination of finite element analysis and design refinement was employed. This comprehensive approach was instrumental in shaping the slab's design to a stage where it could be molded, installed, and tested.

Project Achievements

The project successfully completed and output a commercially viable slab that is ready for use with very light rail vehicles. A collaboration with ARLI at Birmingham University enabled further critiquing of the design using finite element analysis. This further optimised the design reducing the volume of materials required along with the complexity of componentry enabling the slab to have even greater sustainability credentials.

Conclusions

The project stands as a resounding success, holding immense value in advancing the system's development and establishing its technical and commercial viability as a real-world solution. The comprehensive design development, meticulous FEA & FEM analyses, and the impending prototype manufacturing phase have collectively provided conclusive evidence that the solution not only works but also carries the potential for the transformative impact envisioned at its inception.

Next Steps and Future Measures of Success

In the next phase, further testing on the physical slabs once they are installed will be carried out, with the aim of further validating their performance under real-world loads from the R-VLR rail vehicle, and the Freight Skate maintenance bogie. Furthermore, we are set to commence the implementation of the Railsense system, which will autonomously detect rail vehicles, identify failures, and detect any changes to the rail line, such as subsidence, trespassing, or theft. By integrating the SmarTrax system with Railsense, we anticipate a significant enhancement in rail line safety, proactive and predictive maintenance practices, as opposed to the reactive approach currently in use.

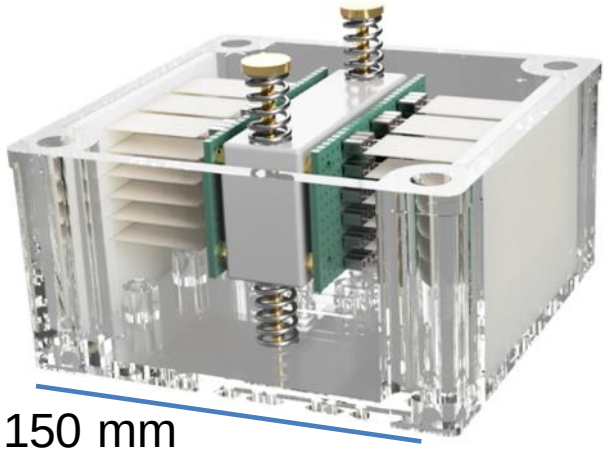
Rail Power LSBU

Open Call

RailPower

Project Summary

This project aimed to design, build, and test a prototype vibration energy harvesting platform suitable for railway environments, which may be used to power IIoT wireless sensor networks without any requirement for batteries. The functional requirements of the product were attachable to rail web – the vertical face of railway tracks, weatherproof and provide sufficient energy harvesting capacity to power wireless IIoT sensors. Non-functional requirements are lower OPEX cost at scale than batteries, proven at TRL 4, a value proposition of the product is based on the following example sensor use-cases such as identify locations prone to rail buckling (temperature measurement) and detect loose track clips, points fixings, and rail crack propagation (high frequency vibration).



Project Achievements

This project demonstrated the feasibility of harvesting otherwise wasted vibration energy from railway tracks each time a train passes over them. A prototype device capable of intermittently powering an IIoT wireless sensor node was proven to TRL 4 in a laboratory setting using calibrated measurement equipment under the guidance of an academic specialising in piezoelectric device fabrication and applications.

When widely deployed to power a fleet of IIoT devices such as surface temperature sensors, vibrometers, and reflectometers, the Railpower product will unlock the next generation of AI based predictive maintenance for the railway industry. It is anticipated that the era of disruptions to passenger journeys caused by phenomena such as rail buckling, low adhesion, and cyclic top will largely become a footnote in history as real-time data visibility is created for thousands of miles of track, enabling these conditions to be identified and rectified long before they develop.

Conclusions

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The delivery team included a subject domain expert consultant in rail engineering, a mechanical engineering academic, a PhD student in electronics, and a research associate with industrial experience in IIoT deployments. They are now ready to establish a market for the product, attract investment, and continue development towards TRL 9.

Next Steps and Future Measures of Success

The next steps in the commercialisation of this product are:

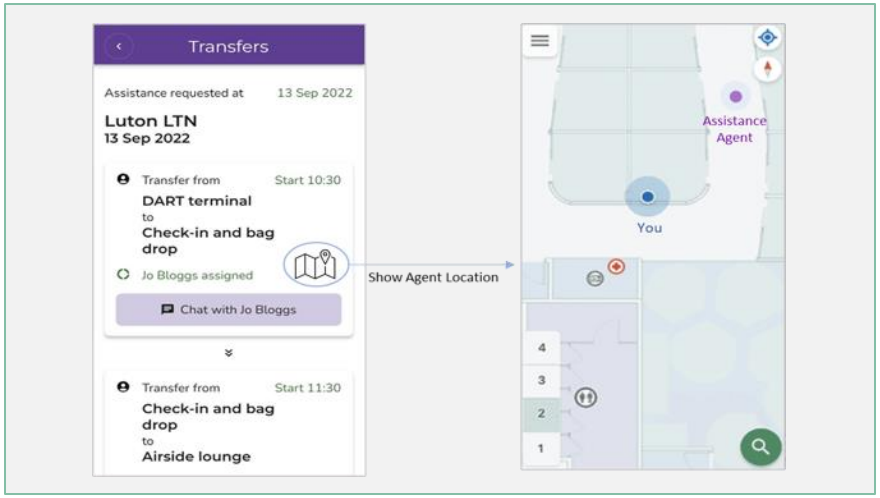
- Run a pilot test at a depot location or rail proving ground with a single prototype device to prove on-site operation
- Partner with sensor vendors to develop an ecosystem of rail-specific sensor solutions supported by the Railpower device
- Enhance our embryonic relationship with Canada Rail
- Run a wide area pilot trial with Network Rail as a partner
- Attract grant and/or VC funding to continue product development and testing out to TRL 9

Ostrum Tech Limited

Project Summary

Ostrum is a digital platform for managing airport special assistance. It is currently deployed at two London airports. The platform helps the special assistance provider to assist passengers and to bring all parties – passengers, cabin crew, agents on the ground, control room etc together using technology.

This project was to do the R&D for enabling indoor/outdoor geolocation on the platform, so that special assistance provider can locate the agent to allocate jobs more efficiently and also enable passenger to see agent's location.



Project Achievements

Our main challenge was to find a cost effective geolocation tech which will work indoor and outdoor. During the project, we studied the technical compatibility of various map/geolocation SDKs with our platform. We evaluated Mapbox, PointrLabs and Google. We integrated Google map, Streetview and geolocation to our platform to demonstrate the capability and to validate the concept with special assistance provider and passenger representative.

The highlight of the project was the demo of this capability to a London airport, which contributed to securing the deal to deploy our special assistance platform there in August 2023.

Conclusions

Passenger rep confirmed that showing geolocation of agents will definitely reduce anxiety and provide reassurance for passengers.

Based on the evaluation of various SDKs, we found that Google maps and SDK to be the most compatible with our platform.

This tech will enable special assistance providers with better situational awareness, find nearest agent for tasks and for auditing agent's activities. Another learning point is that this feature will become a selling point for our special assistance platform, when we try to sell it to future customers.

Next Steps and Future Measures of Success

During this project, we have taken the geolocation idea from TRL2 to TRL6. The next steps are:

1. Integrate the solution to production environment and deploy it for future use by our customers (two London airports)
2. Offer this as an optional commercial service on top of our special assistance platform and see the level of interest.

We are likely to seek funding extending this idea with augmented reality way finding or step free navigation, in the future.

Passenger

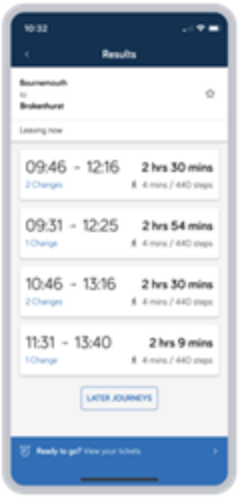
Open Call

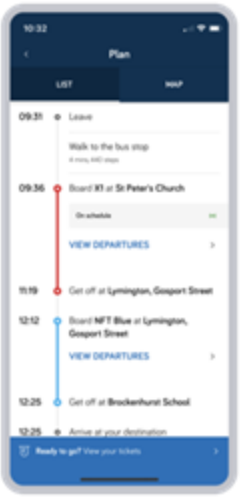
Passenger Technology Group Ltd.

Project Summary

The Safe Walking Routes project seeks to improve journey planning information available to vulnerable travellers. The project builds on a technical feasibility study by Passenger. The research seeks to understand the expectations of users, and to assess whether it is possible to meet their safety needs. The research conducted is broken down into three distinct phases designed to understand the subject of safety and then delve into user feedback on their safety concerns when walking and using journey planning technologies. The three phases of the project are as follows:

- Subject Matter Expert Interviews
- Bus User and Walkers Survey
- User Interviews





Project Achievements

The research project allows us to develop a comprehensive understanding of types of safety and related concerns of users and subject matter experts. This provided a broad understanding of safety in relation to walking and using journey planning tools. This understanding translates to the five areas of safety we identified; physical, psychological, accessibility, road and social. Once understood this enabled us to expand on specific concerns of users relating to each type of safety and ways in which these could be addressed in relation to safer walking routes. We worked collaboratively with our research partners to devise a survey for which we got over three thousand responses. This provided us with rich qualitative data on safety in the context of walking and journey planning. Outputs from the research will support companies that develop and maintain journey-planning software to adopt the guidance as recognised industry best practice.

Conclusions

Key things to note are that safety is complex and subjective, requiring diverse insights to design effective inclusive solutions. There is no universal definition of safety - it is personal, situational and shaped by infrastructure.

In conclusion, this project highlighted needs, envisioned possibilities, and built foundations to progress an inclusive safe walking or journey planning tool that empowers diverse communities. Further research, development and coordinated action are required to realise its full potential. However, the case for investing in solutions that promote safe access for all is now well supported by evidence outlined in this research project.

Next Steps and Future Measures of Success

- Build a digital toolkit to open up the findings from our research to businesses developing journey planning tools in the transport industry.
- Identify further research opportunities that focus on a specific type of safety, aimed at targeting user concerns
- Identify areas where product development can enhance improve user safety concerns
- The TRIG program has allowed initial research to be conducted and shared, which we hope to continue to build on moving forward.

Rock Engineering Ltd

Project Summary

"Rock Climber" is an Open Call Challenge aiming to positively impact four of the DfT's five strategic priorities. "Rock Climber" is an all new powered mobility vehicle that gives users far greater access, and freedom to real-world urban, and country side environments. Thus leading to greater opportunity & equality.

Our objective is to provide a single design solution that vastly exceeds current offerings in terms of size, manoeuvrability, obstacle climbing performance, range of operation and desirability. Rock Engineering wants to provide a solution that gives users the confidence to explore and enjoy their environment whilst having far less reliance on others.

Project Achievements

The focus for our project was to a produce a full design & then manufacture the first prototype vehicle.

The main achievements for the project included the production of a full CAD model of the complete design. This included the development of a detailed design specification, that defined the performance requirements for the vehicle, including targets that the design needed to achieve. In turn this document drove the detailed design of each system including chassis, suspension, powertrain and electrical architecture. Various virtual simulation methods were also used to validate the design prior to producing any parts. This has included methods to test the structural integrity of individual components, as well as simulating whether the vehicle, as a system, has sufficient performance to achieve the maneuverability, and range targets.

Besides producing a fully detailed digital model of Rock Climber the project has also undertaken a full manufacture and build of the first prototype. Rock Engineering has produced much of the components in-house, but has also collaborated with an external company to develop the electronics. Currently the vehicle is in the final stages of manufacture.

Conclusions

The primary project objective was to develop a technology that will provide wheelchair users with improved access to urban & countryside environments, which in turn would result in improved independence, confidence, access to better work and social opportunities, and ultimately improved happiness. The measure of success for the project, therefore, is whether the Rock Climber will substantially improve user access. At this stage this has been validated by virtual methods, i.e. through computer simulations, but this can't be objectively quantified until the first physical prototype has been built. The pragmatic, Engineering led, processes & methods used to complete the project does, however, still give us confidence that the final design will achieve its goals.

Next Steps and Future Measures of Success

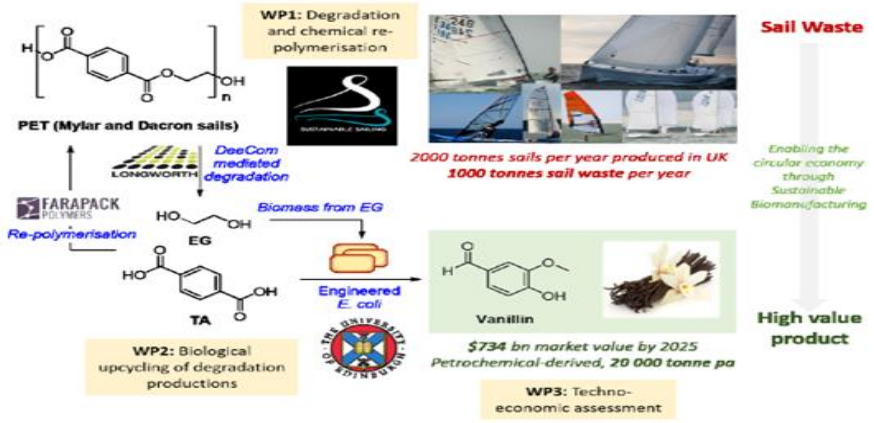
The next steps for the project are to complete the build of the first prototype. A series of physical tests will then be undertaken to confirm performance, validate structural integrity and produce media content that will help identify & promote the accessibility issues highlighted in the project brief. Commercialisation of Rock Climber will require a re-design of the concept to produce a design that is more aesthetically pleasing, and viable for larger scale production. Initial discussions are underway with Huddersfield University to support Product Design requirements. Investment is also required to scale up to production, and discussions have commenced, but are at an early stage

Open Call

Sustainable Sailing

Project Summary

Sails are a major part of maritime decarbonisation ecosystem. The majority of sails (70%) are built from polyethylene terephthalate (PET), which has currently limited end of life solutions available at commercial scale. As a result, there is a significant flow of sails from production to landfill. In this study, the polymer recycling system, DeeCom, was applied to PET sails. These recycles were then used to resynthesise PET precursors. Recycled PET has a relatively low value, so the recycles were also used as a feedstock for an engineered strain of E. coli (pVan1), to bio-synthesise vanillin, a high value product.



Project Achievements

This study sourced two end of life (EoL) sails and incorporated them into the DeeCom process. Both of these sails were processed through DeeCom and the recyclates from the process were purified from the aqueous phase, for downstream identification, quantification and utilisation. All DeeCom activities were undertaken in collaboration with B&M Longworth, the inventors of this innovative process. Life cycle assessments indicates that, assuming linear scaling, DeeCom was an appropriate recycling process, with a lower carbon footprint than landfill for sails.

The aqueous phase recyclates were identified as primarily terephthalic acid (TPA), through a range of analytical techniques undertaken by Farapack Polymers and the Sadler Lab in the University of Edinburgh. This TPA was reincorporated into a chemical resynthesis pathway to produce BHET, the precursor of PET. Alongside this, because recycle PET is still relatively low value, the recovered recyclates were utilised as a feedstock for an engineered strain of E.coli. This strain had directly comparable growth upon the sail recyclate as reagent grade TPA, with high transformation efficiency of TPA to vanillin (79%). Techno-economic assessment of vanillin synthesis, form this source, indicated that, this step would dramatically reduce the costs of sail recycling.

Conclusions

This project successfully demonstrates that there is a clear end of life pathway for PET derived sails, through DeeCom. In addition, there are clear pathways to commercialisation, through the resynthesis of PET or, the bio-synthesis of vanillin. Preliminary life cycle assessments indicate that DeeCom as a batch process operating at the 20-sail scale, is a lower carbon footprint alternative for sail disposal than landfill, while producing PET monomers. If this can be successfully scaled up, these technologies could have the potential to be appropriate, low carbon, end of life solutions, for sails.

Next Steps and Future Measures of Success

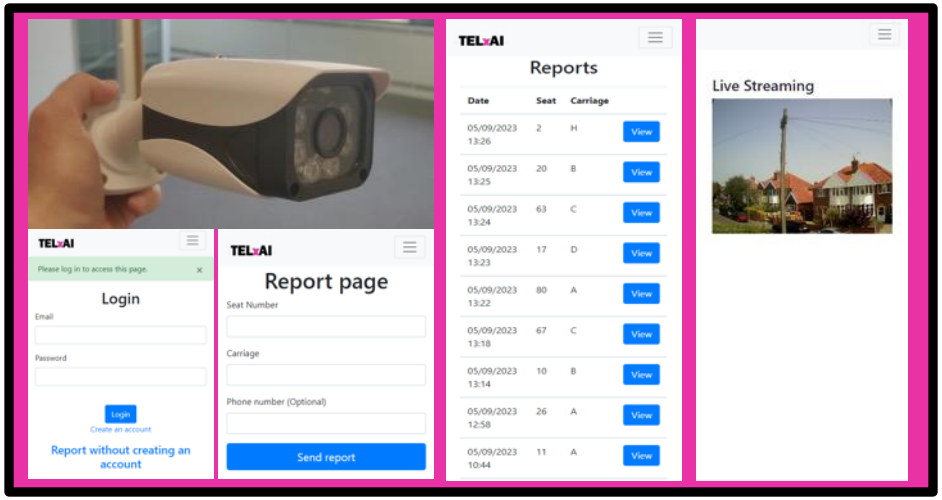
A range of activities now need to be undertaken to move these technologies form the individual sail level, to address the global challenge of sail waste (approximately 2000 tonnes). Specifically, demonstration projects are now being planned and designed to operate DeeCom at the scale necessary to process at least one tonne annually, to recycle sails. This is alongside effort to begin commercialising this as a recycling service, through stakeholder groups that we have approached and been approached by throughout this project. Currently the pathway to commercialisation requires some important process innovations, which are now part of ongoing development projects. We are therefore aiming to utilise grant funding, through projects such as the clean maritime demonstration competition, to reach this multiple tonne scale, while simultaneously planning our first fund raise through the sale of equity. None of these aims would have been within our consideration without the TRIG program funding, which has successfully transformed our value proposition to investors and other grant funding bodies. We hope to have recycled at least one tonne of sails by the end of 2024.

Open Call

TELXAI formally TelWAI

Project Summary

The TELXAI project focused on enabling passengers in distress to covertly communicate that they require assistance. TELXAI facilitated this capability by developing an API that communicates with the TELXAI camera. The camera then pushes these alerts onto staff and law enforcement who can utilise the camera as a point of visual verification and situational awareness. Primarily developed as a solution to aid in enabling women who feel harassed or unsafe to alert staff to their situation, the solution developed has a wide range of use cases in safety and mobility.



Project Achievements

Our project focused on two primary deliverables, the development of the API reporting tool, and the retrieval of the API alarm within the camera. Our main achievement of the project was the development of these functions. To deliver this capability TELXAI integrated additional hardware functions into its camera and built the software communications functions. By developing these functions TELXAI has been able to demonstrate these features to potential future customers and identified additional use cases.

Conclusions

The project was successful in developing and demonstrating the functions TELXAI sought to develop. The outputs included the TELXAI API and a next-generation of TELXAI camera. By implementing this project TELXAI has also made commercial gains and has identified additional use cases in markets such as autonomous transport. TELXAI has also identified additional follow projects to demonstrate the system functionalities in live environments.

Next Steps and Future Measures of Success

The next steps needed to progress the technology to commercialization is the implementation of live trials, enabling passengers to actively use the technology. This includes deploying cameras in train stations and on trains and integrating the TELXAI API into apps such as the Trainline app. TELXAI is actively in the progress of identifying and submitting proposals for live trials. One of these proposals includes the submission of live trials in partnership with South Western Railway and wireless network providers. These submissions will enable TELXAI to raise additional funding and demonstrate to potential investors that its technology is market ready. The TRIG program has been substantially beneficial to TELXAI, it has provided TELXAI with the funding and guidance needed to commercialise its innovative technology.

The Open University

The reality of driver distraction: Innovating education using virtual reality technology to improve road safety

Project Summary

Mobile phone use by drivers remains a significant road safety issue requiring educational interventions aimed at deterring this form of driver distraction. We have designed and tested a mixed reality approach to driver education and research, developing an immersive experience which allows drivers to safely experience the effects of their own distraction, with a view to changing future behaviour. Based on this work, we have created an open box toolkit of mixed reality resources which can be applied to multiple areas of road safety, including workplace training, driver education and academic research.

Project Achievements

The project led to the creation a mixed reality environment that leverages video pass-through technology to test and train drivers interactively. We created both 360-degree video and CGI virtual driving environments. The novelty in our design is the mixed reality approach. Our testing demonstrated the ability of our selected technology to personalise the vehicle environment, allow the user to engage effectively with their own mobile phone, and to interact with a virtual environment which closely resembles real-world experience, without any issues of user discomfort and high ratings for immersion and realism. The ability for the user to interact with both the real and virtual worlds simultaneously provides huge potential in terms of research, training and educational applications. The potential impact of a mixed reality approach to driver education is far reaching, not only for the policing and deterrence of offending by the general public, but also for educating industry and public sector fleets and other groups of professional drivers, improving road safety for everyone.

Conclusions

This project has demonstrated clear proof of concept by assessing technology and devising a workable approach for testing and training. Paired with psychological expertise, based on empirical investigations on both the distraction imposed by phone use, behaviour change interventions, and best-practice in policy, this project provides a solid grounding for development of a range of mixed reality road safety training, education and research approaches. The toolkit we have produced, sharing the development process, provides jargon-free guidance on the creation and application of mixed reality approaches.

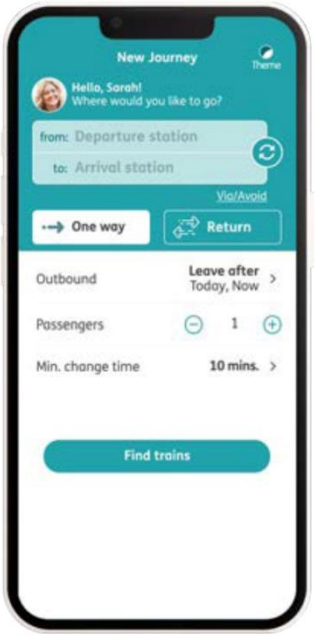
Next Steps and Future Measures of Success

1. Dissemination of the toolkit via knowledge exchange and networking events.
2. Application for further funding to create a market-ready mobile phone education intervention using our mixed reality approach.
3. Scoping of application of mixed reality approach to other areas of road safety.

Transreport Limited

Project Summary

Our project looked into making air travel more accessible by making the interactions and information more accessible when making journeys. Our aim is not only to improve the existing technology systems in use, but also to improve the social understanding of providing assistance to disabled and older passengers. Keys activities included working with disabled and older passengers, as well as, assistance providers and operators within the aviation industry. The core end deliverable is a desktop prototype. It leads to DfT priorities of improving journeys; safe, secure and sustainable transport; and boosting economic growth.



Project Achievements

Our biggest success is to move our thinking and technology forward to TRL 4. Our biggest challenge was ensuring design-thinking that is universally applicable to all operators within the aviation industry, and not just a subset. This was overcome through engagement with with industry stakeholders for feedback to ensure the appropriate approach is being taken.

Conclusions

We have an illustrative prototype. Our project was successful in what we set out to achieve. We were able to move our technology forward to the next TRL, and now will be further developing it accordingly. We re-enforced our approach of collaborative design, with this being a key lesson learned.

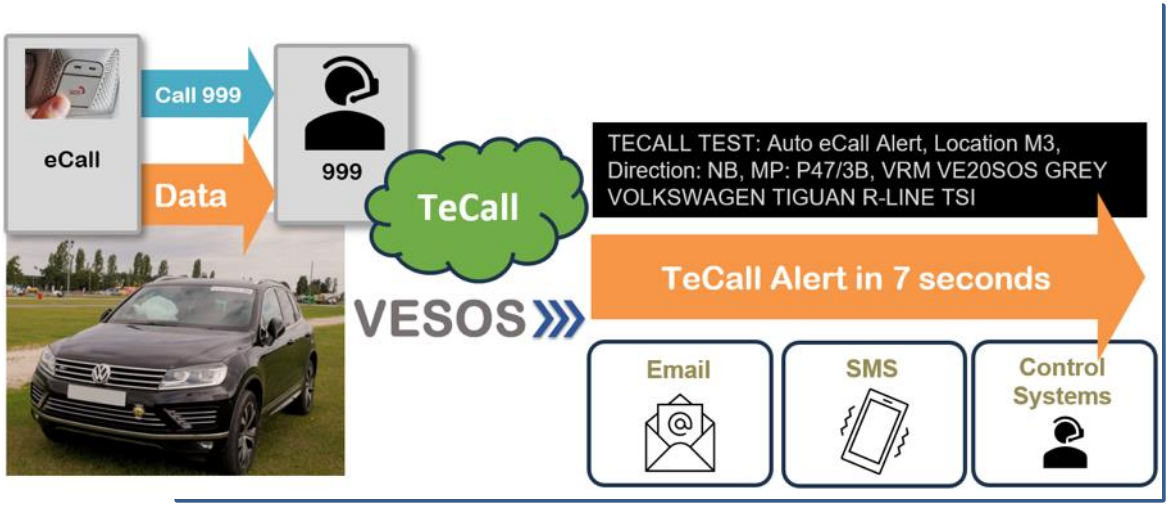
Next Steps and Future Measures of Success

Our next steps are to build a larger scale product that will be validated in controlled environments
We have interested stakeholders for when we move forward, with commercialisation possible upon further validation..
The primary benefits of the TRIG programme was the mentoring providing which led to consistent focus on delivery.

VESOS Solutions Ltd

Project Summary

We have showed (through an end to end proof of concept called TeCall) the maximum use of eCall data already available from new UK cars and van since 2018. We use this to detect collisions more quickly and improve emergency service and road operator responses in locating and responding to crashes, so saving lives and reducing crash severity. We can use this untapped golden nugget data to identify drivers and vehicles with special or equality/ inclusivity needs eg electric and wheelchair adapted vehicles



Project Achievements

We focussed on the processing of eCall data already in use (10,000 calls a month) to maximise its value and make it simpler to use operationally. Our main achievement was comparing the time taken to respond to voice calls to 999 with the TeCall response, which saves 1 minute in locating a vehicle and 5 minutes in road operator response setting. A further highlight was linking our TeCall output with other systems for example in vehicle signing and email messages to traffic authorities. We collaborated with several police forces and fire & rescue services and their IT suppliers, Motability to address EDI issues, DfT, The RAC Foundation, KL Systems, National Highways.

Conclusions

The proof of concept showed significant time savings and added value data over and above the voice elements of eCall already in use , Our business case showed this could save lives on UK roads, especially in rural run off collisions, and for “lost” vehicles that are not immediately found. We did however learn that there is very poor awareness of eCall not just in the public but in the 999 services and with road operators, and that the eCall data is not easily available for 999 use. We will be working with government to address this.

Next Steps and Future Measures of Success

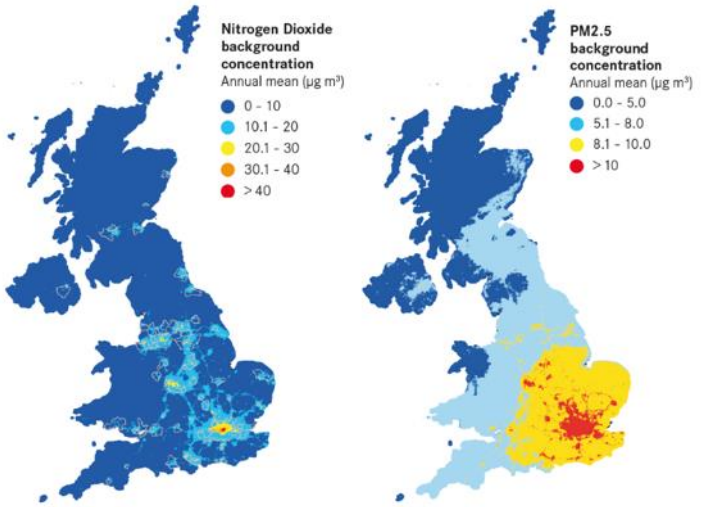
We propose a large scale live test of TeCall with real data from 999 systems and evaluation of the benefits to road operators and road users , especially for inclusion
We are already discussing the use of TeCall with foreign road operators, as eCall is a global system
We are exploring funds for supporting this live demonstration but need no further funds to develop TeCall
TRIG funding has helped us with a depth of analysis we couldn't have undertaken ourselves and opened doors, raising awareness of eCall

WeCare4Air
Understanding Air Quality matters

Open Call

WeCare4Air

Reference grade, self calibrating chemiluminescent sensors for accurate transport air quality monitoring and automation of mitigation solutions



Project Summary

Throughout the UK there are cars and other road vehicles contributing to pollution along the roads. We have designed a roadside monitoring system which can be attached to lampposts, gathering air quality data. We looked to miniaturise existing reference grade technology in order to obtain accurate data from these systems. This allows us to better understand the impact of vehicles on air pollution and work towards a more sustainable future.

Project Achievements

Our project focused on creating a Monitoring system for gas and particles in air on UK roadsides, and miniaturise existing reference grade sensors for use in these monitoring systems.

We have designed a system to sample data at a given frequency and automatically record this and upload the data.

We produced a prototype and tested the functionality and accuracy of the system.

We designed a miniaturised chemiluminescent sensor and tested a prototype.

Conclusions

The monitoring system worked as intended, being a small, cost effective way to measure air pollution.

The miniaturised reference grade sensors showed promise, but issues with clogging up means that further work is required to improve these.

This system can help us understand how different factors impact air pollution, in both cities and rural locations. This could be used to automate traffic systems to mitigate and avoid high pollution areas.

Next Steps and Future Measures of Success

We are aiming to use this prototype as a platform to build upon, improving the accuracy of the data and adding more features to the system.
We have obtained a grant with InnovateUK, and are working together with AI experts to integrate AI into the system.
With further work on the miniaturised chemiluminescent sensors, we will hopefully be able to push towards commercialisation for these sensors.
Being on the TRIG programme has provided an excellent platform to work with, and develop an understanding of smaller, compact sensors.

Funded by
UK Government

Maritime Decarbonisation

Delivered by

CATAPULT
Connected Places

Achelous Energy Ltd

Project Summary

As the maritime transport industry seeks to reach Net Zero by 2050, small ports and marinas often struggle to identify and establish inexpensive, reliable means of decarbonising their electricity supply.

The aim of this project was to establish whether small-scale deployments of "hydrokinetic" technology – technology that uses the movement of flowing rivers or oceanic tides to generate power – could provide a potential solution to small ports and marinas as a means of decarbonising.

Project Achievements

Two small (200W) hydrokinetic turbines were specially designed, and deployed to a UK marina for a period of five-weeks. Each turbine system was linked to a full electrical power generation system, and used to provide charge to a battery. The turbines were deployed to the water using a shore-based gantry system, which leveraged some of the existing, unused infrastructure of the marina; in this case a floating pontoon.

The project helped initiate and establish a relationship between AEL and Marina Developments Limited (MDL), one of the UK's largest owners and operators of commercial marinas.

Conclusions

The project concluded that the deployment of hydrokinetic technology to existing shoreside infrastructure at small marina and port locations in the UK can provide an economically-viable method for helping these businesses to decarbonise their electricity supply.

Hydrokinetic power generation is a cost-effective, scalable and environmentally non-invasive way of supplementing the existing wind and solar electricity generation adopted around the UK. Where hydrokinetic turbines can be deployed to continuously flowing riverways, the technology also offers the prospect of generating baseload renewable power.

Deployment of 2,000 1.6kW-rated units could offset up to 5,000 tonnes CO_2e/year.

Next Steps and Future Measures of Success

- Installation of a cloud-based monitoring system to enable remote monitoring of the power generation of the turbines, and water flow speed.
- Design refinement of the turbine blades, using marine-grade aluminium instead of steel as the internal strength members to facilitate installation.
- Design of commercial-for-production turbine gantry structures using marine-grade aluminium, and issue of Requests for Quotation (RFQs) to UK aluminium fabrication yards for costing.
- Detailed examination of additional MDL marina sites for possible commercial turbine deployments.
- To sign a contract for the supply of hydrokinetically-developed electricity with a commercial off-taker within a period of 12-18 months from the end of this project.

Bluewater Engineering Limited

Project Summary

This project aimed to de-risk the SKYTUG concept by demonstrating proof of concept of its airborne kite handling system. SKYTUG is a wind-propelled ocean tug intended to tow cargo ships at full service speeds using only wind propulsion, by means of a series array of large kites, thereby dramatically reducing their greenhouse gas emissions. A standard 'SKYTUG 50' design will be capable of 24,000 tonnes of CO_2e savings per annum, or considerably more in regions of the world's oceans with favourable wind conditions.

Project Achievements

- Prototyped and developed runners for kite launch transit.
- Tested aerodynamic devices and determined best options and setup.
- Determined force and power requirements for kite steering.
- Validated parts for kite control units and finalised design.
- Prototyped and developed kite control units.
- Planned for flight trials to take place soon.

Conclusions

- Functionality of runner system and kite control units is good.
- Electromechanical kite control at small scale is possible.
- Weather constraints severely limit testing opportunities.
- Future work needs to bring forward development of tools, aids and mechanisms to improve ground handling of kites in varied weather.

Next Steps and Future Measures of Success

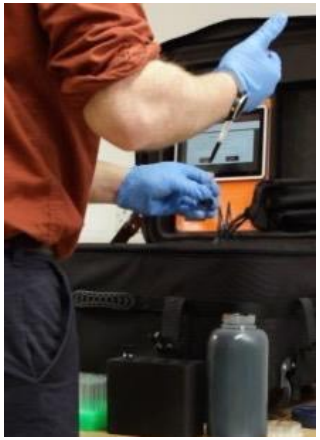
- Complete successful proof of concept trials.
- Brief known and new potential investors about success and secure additional funding.
- Pursue engineering development of full-function kite system and integrated seagoing demonstrator.
- Further pursue discussions which are currently under way with potential partners about system integration into vessels.
- TRIG has enabled a lot of engineering work for the prototype kite system, and raised exposure of SKYTUG and credibility with industry.

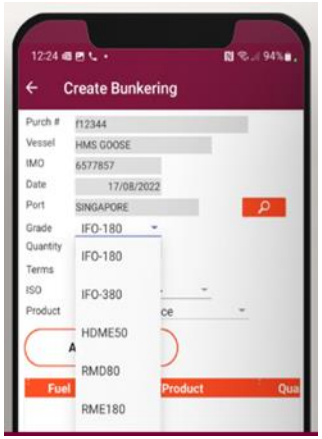
BunkerTrace

Project Summary

The maritime industry is responsible for 3% of global greenhouse gases and it is no longer acceptable to rely on low-cost, bottom of the barrel oil sources. As new low-carbon fuels enter the market, consumers are demanding evidence that these fuels not only meet specific quality standards but are also produced in a sustainable manner.

Our objectives were to research, develop and validate techniques for molecular tagging of fuels and to develop a prototype digital reporting tool for life cycle emissions. Scope was confined to customised markers for biofuels and e-methanol and laboratory testing to evaluate feasibility.





Project Achievements

BunkerTrace gained valuable insights into the performance and applicability of our markers in biofuels and e-methanol. The proof-of-concept demonstrated feasibility, and the outcomes of the project validated the creation of novel markers and associated analytical techniques, as well as a complimentary digital reporting tool. The project achievements include:

- addressing marker stability challenges in specific fuel types
- developing novel and promising marker technologies in response
- achieving dissolution and stability of these markers in the fuel types
- development of a digital prototype for LCA and emissions reporting
- linking prototype to molecular marker codes
- justification for continued development and investment

Conclusions

Participating in this grant-funded project has not only yielded technical advance but also offered several additional benefits for our business of enhanced expertise, creation of a more diverse marker suite and increasing commercial viability by moving from TRL3 to 5.

We intend to continue developing this product in collaboration with research institutions and e-methanol producers across the UK. This collaborative approach will further our goal of enhancing sustainability verification within the maritime industry and contribute to our team's long-term success.

Next Steps and Future Measures of Success

The results of this project encourage us to believe that, with further development, this product has promise for commercial viability and scaling. We would like to continue the development of this product and focus solely on e-methanol. We would seek additional grant funds for this work based upon our findings and outlined next steps from this project.

Next steps in marker development we would like to explore include the effect of different temperatures on marker stability; refining the detection methods to improve precision; and complete longer term stability studies at different temperatures. For the digital LCA and emissions reporting tool, the next steps are to code the new product based on the specifications; integrate it to the existing mobile application; and develop encoded protocols for detection on firmware. All products would then be tested in a real-world setting for an e-methanol bunkering in port.

C-MAT Technologies Ltd

SEFAD-2 (Ship Emission Filtration and Decarbonisation)

The global shipping sector annually releases approximately 1.06 billion metric tons of carbon dioxide into the atmosphere. This accounts for about 3.0% of the total global CO_2 emissions resulting from all human activities, and hence it becomes clear that the shipping industry plays a crucial role in contributing to climate change. This alarming environmental impact underscores the pressing need for innovative solutions within the maritime industry.

C-MAT Technologies' mission is to combat climate change and significantly reduce the carbon footprint of ocean-going vessels. With our cutting-edge carbon capture Metal Organic Framework (MOF) technology, we aim to revolutionize how emissions are managed both at sea and in port, making a substantial contribution to global CO_2 emission reduction targets.

Project Achievements

- Upon the completion of this project, the SEFAD technology has reached a Technology Readiness Level (TRL) of 3-4.
- In order for C-MAT to establish market share with new technology in the market, it is critical tC-MAT has the ability to predict the carbon capture potential rates of the SEFAD technology and that the figures presented to the customer/end user are credible and accurate. The initial, prototype model has been developed in the MATLAB/Simulink programming environment that.
- Discussions with classification societies have been commenced, to ensure that all necessary certifications are prepared for when the product is market-ready

Conclusions

The incorporation of onboard carbon capture utilization and storage (OCCUS) technologies like C-MAT SEFAD represents a highly effective technology, serving as an alternative to the rapid deployment of approaches striving for Net-Zero emissions. Nonetheless, the malleability inherent in the design of porous MOFs opens up the prospect of adapting and applying this technology for a multitude of purposes, including the storage of emerging fuels such as hydrogen and ammonia.
Nevertheless, there is a requirement to incentivize investment, particularly in onshore infrastructure; demonstrating real-world performance is essential; shipping should establish connections with the broader carbon industry; additional policy measures and regulations are required.

Next Steps and Future Measures of Success

To expedite technology development without delays, C-MAT has forged a strategic partnership with University College London (UCL) and TOPE Ocean to seek additional funding in the upcoming round of the Clean Maritime Demonstration Competition – round 4. C-MAT has initiated dialogues with industry stakeholders and has received support from multiple public and private sources.
C-MAT is currently focused on the next stages of SEFAD development and in particular the design of system components and integration of the technology into a ship system. TRIG programme provide us the exposure we needed to initiate the conversations with potential stakeholders and investors.

Cranfield University

Project Summary

Maritime shipping is highly fuel-efficient, responsible for 90% of global trade with only a 3% contribution to anthropogenic CO2 emissions. Yet, increasing environmental regulations, especially related to harmful pollutants, pose challenges. Implementing green cargo tech is complex due to the immaturity and unproven effectiveness of some technologies. To address this, we propose using bio-inspired flexible foils for thrust generation and ship stability. This cost-effective innovation supports the transition to zero-emission navigation, vital for sustainable maritime transportation.

Project Achievements

Our team's extensive feasibility study shows our proposed technology can achieve a significant 20% fuel reduction in the target maritime market. This breakthrough is vital for cargo ship efficiency and combating carbon emissions in the industry. Our technology has advanced steadily on the Technology Readiness Level scale, with a successful lab demonstration as a key milestone. We've also published two influential papers on wave-devouring propulsion to share our progress and research impact.

Conclusions

We are confident that wave-devouring propulsion technology represents a promising and effective approach for addressing the urgent challenge of marine decarbonisation. Our research endeavours in this field have yielded substantial evidence supporting the viability of wave-devouring propulsion. Both extensive numerical simulations and rigorous experimental studies have consistently demonstrated a remarkable 20% reduction in fuel consumption when employing this technology.

Next Steps and Future Measures of Success

We have collaborated with the Technology Transfer Officer (TTO) at Cranfield University to advance the technology to higher Technology Readiness Levels (TRLs) and commercialise it. We have utilized various channels, including the company's website, digital media platforms, and social media, to reach a broader audience. Additionally, we are engaging with other shipping companies to secure further funding through the CMDC4 project, which involves four other companies and another academic institution.

Duodrive Limited

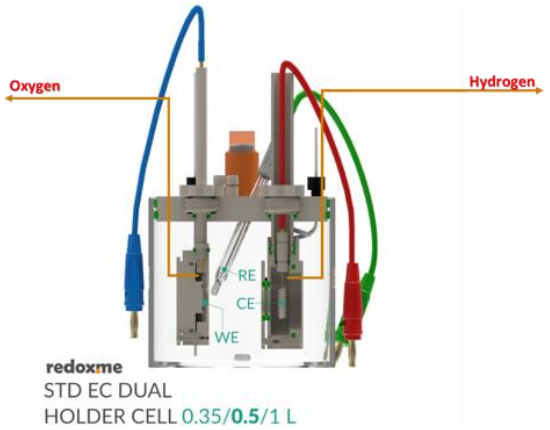
Project Summary

This project will develop the key components for a novel commercial "Brown Gas" or HHO generator/electrolyser using seawater feedstock to supply "ignitor" gas to feed to a Marine combustion engine for which the primary fuel will be Ammonia.

Proof of concept to investigate choices and discover optimum combination of :

- forward osmosis-water splitting (FOWS) membrane
- anode/cathode material
- compact size to be accommodated on small ships
- and to combine or separate gas flow

and to validate in a lab or testing environment.



Project Achievements

Project focus was to establish a stable production of Hydrogen and Oxygen for which our approach has the more advanced idea of using natural seawater as that makes up >96% of global water supply. For that latter reason there is now considerable interest in the electrolyser research community to develop electro-catalysts, membranes and electrolysers that can work without the historic step to obtain first purified water processed by energy intensive purification / de-salination systems. De-salination systems using reverse osmosis (RO) are already commercially available, but consume significant electrical power.

Tees Side University was chosen as academic sub-contractor as their Hydrogen laboratory has all the necessary facilities for testing electrochemical cells. Cardiff University was also selected to provide key Consulting inputs for the development of the core Intellectual Properties.

Conclusions

Opportunity to Network with other innovators realised some fruitful avenues to explore post-project whilst a comprehensive literature review has been carried out to have the baseline to understand where current work by others had progressed.

The step-change potential suggested by this project compares very favourably with the savings in carbon emissions & the promotion of UK technology with no worldwide equal.

The Industrial Sandpit Event, Growing Teesside's Hydrogen Economy organised by the Net Zero Industry Innovation Centre has enabled Duodrive to register a direct interest to be a prime company on Seawater Hydrolysis under Tees Side as well as to work with Durham on Liquid Hydrogen.

Next Steps and Future Measures of Success

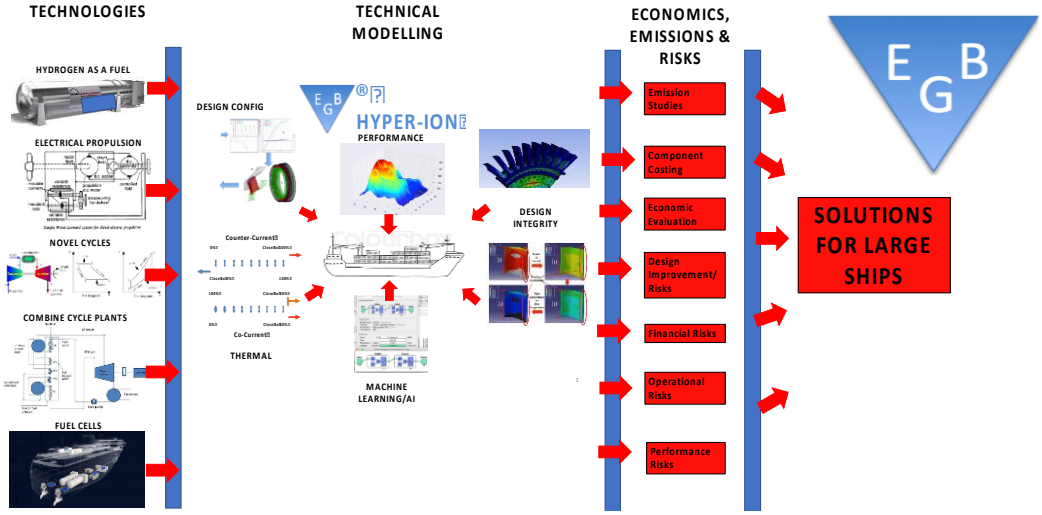
Duodrive are currently running an InnovateUK funded project : "High Efficiency Hydrogen/Ammonia Engine Generator" we will look to take the next steps to raise the TRL by carrying out a "live test" of a prototype hardware derived from the T-TRIG2023 outcomes. In respect of Marine themed Funding, there is the final tranche of the CMDC or Clean Maritime Demonstration Competition – Phase 4 (closing date 27 Sep 2023) for which a submission is under preparation.
Tees Side and Durham Universities have embarked on a £11 million project, funded by Research England, to support hydrogen innovation in the Tees Valley across three domains of heat, power and transport. Our T-TRIG2023 Project has enabled Duodrive to register interest in the Hydrolyser theme (2 strands with Tees Side University) and plans are underway with a major Tees Side based chemical company to seek out a funded project which could capitalise on a peripheral aspect of the "Proof of Concept".

EGB Engineering

Project Summary

Decarbonisation of **M**aritime using **A**dvanced **P**ower and **P**ropulsion **T**echnologies (**DeMAPPT**), aimed to develop modelling capabilities to concurrently investigate the feasibilities of numerous technologies to bring about reduction in emissions from large ships.

DeMAPPT methodology focused on 4 key areas; **Container Ship Hull Design**, **Propulsion Plant Configuration**, **Alternative Fuels**, and **Mission Profiles (short, medium and long range),** using in-house tools to model and simulate the ship operation configurations and mission profiles, with respect to key technologies. These technologies include hydrogen as a fuel, electrical propulsion, novel engine cycles, combine cycle plants and fuel cells



Project Achievements

- Developed comprehensive models capable of providing insights into the carbon dioxide emissions resulting from various combinations of hull designs, propulsion systems, and fuel choices.
- Determined the most economically advantageous low-carbon technologies.
- Understood gaps to accelerate development paths.
- Influence policy and direction for investments.
- Determined technologies to support decarbonisation of maritime.

Conclusions

Hydrogen demonstrates the most fuel-efficient performance, with the lowest fuel consumption relative to diesel Internal Combustion Engine (ICE).

Hydrogen has the highest costs associated with any refit and operation, with ammonia-based configurations being the most cost effective.

The project has been successful in proving the concept and providing data that will support the next stage of development. Learning came from Interdisciplinary collaboration, utilising skills in engineering, design, modelling, simulation, data science, understanding of maritime technology and emissions.

Next Steps and Future Measures of Success

DeMAPPT is at advanced stages of development, and the next crucial steps involve transitioning from simulations to live test environments. Our immediate priority is carrying out rigorous field trials and operational testing in order to move further along the Technology Readiness Level (TRL) path towards commercialisation.
The concept has shown success in simulations of ship designs; its real-world viability will be established through these live tests, and we are currently in the process of applying for further funding to progress this. This phase will allow us to confirm the technology's performance and reliability under practical condition.
During the project, we established valuable collaborations with key industry stakeholders and research institutions. TRIG benefits include access to business and investment readiness programmes, marketing tools, network channels and useful contacts with other organisations including DfT, and upskilling apprentices.

GT Green Technologies

Project Summary

This project showcases the feasibility of an innovative wind propulsion system, AirWing, aimed at reducing maritime fuel costs and GHG emission. GT Green Technologies (GT) will develop and obtain AirWing class approval in principle (AIP) from Bureau Veritas (BV). BV are a third-party examiner who will assess regulatory compliance of AirWing from a structural, operational, and technical perspective and ensure no major obstacles prevent AirWing commercialisation. The scope of this project will entail GT constructing and finalising documents for entry into AIP process, updating and developing documents required by BV throughout the process and BV conducting examination and issuing certification.

Project Achievements

The project's focus was to verify that the design of AirWing is feasible, achievable, and contains no show stoppers that may prevent further design development. The project verified that the design was suitable for use in all life cycle phases, such as, design, manufacturing, transportation, installation, operation and, maintenance.

A manufacturability assessment was conducted using The Manufacturing Technology Centre's (MTC's) Design for Manufacture and Assembly (DFMA) method. Based on design requirements, design maturity and relevant material criteria, this identified the most suitable methods to manufacture AirWing parts. A modular design approach was also utilised to reduce AirWing design, manufacturing, assembly, installation, and servicing costs.

A key achievement of the project was collaboration with Carisbrooke Shipping (UK). GT has recently installed a mast on a Carisbrooke Shipping Vectis 11k vessel to obtain wind data prior to full-scale installation. Demonstration is scheduled for H2 2024. The primary aim is to assess AirWing's operational efficiency. Data from the demonstration will be used to quantify the potential reductions in fuel consumption in various weather conditions, sea states, and ship operating points. This will be used to derive reductions in GHG emissions associated with AirWing fuel abatement and will be a crucial step towards AirWing commercialisation.

Conclusions

TRIG funding has allowed GT green technologies to gain successful AIP from BV. This indicates that there are no technical show stoppers to prevent further development of AirWing. Furthermore, this indicates that the design is suitable for use in all phases of operation including design, manufacturing, transportation, installation, operation, and maintenance. In response to feedback from BV, where necessary, design adjustments for regulatory approval will be established and actions taken to mitigate any issues.

Next Steps and Future Measures of Success

Being on the TRIG programme has given GT the opportunity to develop and work towards gaining AirWing class approval in principle (AIP) from Bureau Veritas (BV). BV are a third-party examiner who will assess regulatory compliance of AirWing from a structural, operational, and technical perspective and ensure no major obstacles prevent AirWing commercialisation.

Following successful AIP from BV, GT's next step towards commercialising AirWing is a full-scale demonstration on board a vessel. This is planned to take place on a Carisbrooke Shipping Vectis 11k vessel in the second half of 2024. GT is also in the process of reaching out to vessel owners to raise AirWing customer awareness. Since doing this, GT has most recently received interest from Union Maritime, Zodiac Maritime, Star Bulk and Pacific Basin. However, Zodiac Maritime, as well as other previous vessel owners have expressed the need to see data from a demonstration project before further considering using the new technology.

JET Connectivity

Project Summary

Via the use of large buoys, we can provide at sea refuelling. Our buoys have significant excess power generated via solar on board and also have a backbone with 5G services, connectivity is critical for the delivery of offshore services. This project builds on the 5G buoy digital ocean platforms we have developed. We have Investigated and developed an experimental proof of concept capability to generate and store hydrogen on board these platforms, creating an in ocean zero carbon refuelling hub for the emerging wind farm build, wind farm service vessels and other vessels that may not want to return to port to refuel.

Project Achievements

The project was successful as we were able to successfully demonstrate a working platform and also build up a feasible and viable financial model with a cost per KG not far different to the market norm. For us at this stage we were looking for a ballpark figure and that was met.

Conclusions

In conclusion, the project has been a huge success, we have not only proven the technical feasibility, but we have also proven the financial viability and secured a potential route to market. Further benefits of the TRIG program have been in terms of networking and enabling us to have routes to partnerships in the sector.

Next Steps and Future Measures of Success

We are now seeking funding for development of full scale test system, this will be whilst we firm up a commercial customer to trail with. We think this is likely to be at a significant scale up from the existing lab system. We would also like to then take the project into a live testbed environment, we have a number of different floating platforms available for this, but we would need to grow a clean maritime consortium a little further to enable this to happen. This would be via a number of partnerships that we will be forming up. We have built a collaboration within this project, and as such from this we will look to forming this close for a follow on stage, and also seeking a trial customer.

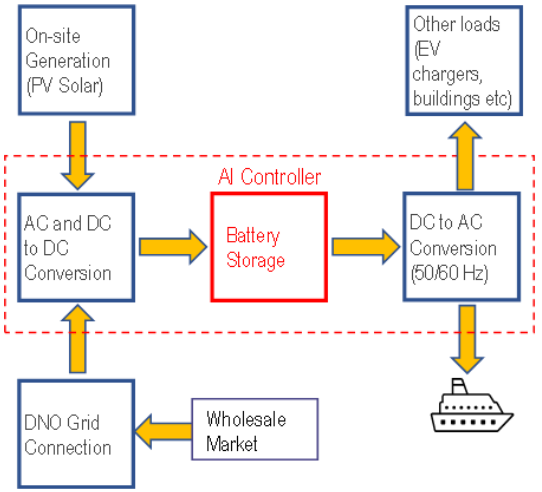
MSE International

Project Summary

ESSOP addresses cost-effective shore power solutions. The electrification of vessels demands significant power provision at berth, incurring high grid energy costs and conflicting with Demand Side Response measures. Battery storage would avoid these problems by time-shifting loads and enabling the storage of energy from renewable generation. Battery options were modelled to demonstrate performance in a number of operational use cases.

Aims:

- Build decision-support tool
- Compare battery technologies
- Quantify savings
- Demonstrate PV solar optimisation
- Model three load use-cases: Infrequent high-power; Frequent low-power; Periodic medium-power
- Promote to the ports & terminals sector
- Application of tool to assist investment planning



Project Achievements

The project has successfully modelled the operation of different storage types under a range of duty cycles, and with varying levels of in-port PV solar generation. Real-world wholesale electricity price data and PV solar productivity, alongside battery cost and performance data from desk research, has been used.

A levelized cost of energy delivered by storage algorithm has been developed, including PV solar. This shows a wide variation of delivered energy cost depending on the duty cycle, including use-cases where optimised battery storage and PV solar achieve a cost lower than £200 per MWh.

Communications activity has attracted a useful level of interest in the ESSOP capability. Collaboration with a first-mover harbour authority has been established, considering how ESSOP could inform their ongoing decarbonisation investments

Conclusions

- In-port battery storage can offer a cost-effective solution to port energy management, allowing PV solar resources to be optimally exploited;
- Battery storage is especially valuable for high-cycle use-cases, for example ferries that need shore power several times per day;
- Although lithium-ion batteries are market leader with lowest capital cost, vanadium flow batteries appear more attractive in high-cycle applications due to their longer life;
- The ESSOP tool needs refinement in terms of its ability to model a port microgrid. It is likely that a DC microgrid would offer significant benefits in terms of efficiency and cost-effectiveness.

Next Steps and Future Measures of Success

The ESSOP tool has demonstrated that detailed modelling of a port energy system in a dynamic electricity market is needed to understand behaviour and cost-effectiveness. The tool is presently designed for in-house consultancy use. Further refinement to cover a wider range of use-cases and improved data quality are justified.

Discussions with several early-adopter users has generated interest, and one harbour authority is aiming to use ESSOP data to inform its decarbonisation options.

The project has highlighted the potential role of DC microgrid architectures in port energy systems, and extension of the ESSOP model to properly model such architectures should be considered.

Port of Tyne

Project Summary

ANT4Ports goal is to assess the economic, ecologic, social, operational impact of using electric heavy duty robots, developed by ANT Machines, for yard operations in the Port of Tyne. ANT yard robot is intended to facilitate the decarbonisation process, address truck driver short and increase overall operational efficiency. During the project we validated applicability, advantages, and operational benefits of different control options, as well as hardware fit for port operations and intralogistics in general. Result – validated data to serve as basis for product commercialisation plan.

Project Achievements

The outcomes of the POC trials align with our initial goals and expectations. The project unfolded as planned, and we successfully demonstrated the viability of the technology in a real-world port environment. The trials not only showcased the capabilities of the electric heavy-duty robots but also illustrated their potential to deliver substantial operational benefits.

We performed coupling with various types of trailers/chassis used in the port, tested remote and telematic controls outdoors, as well as telematic controls from a control station installed in office premises.

Conclusions

The POC trials in the Port of Tyne were executed according to the established objectives, confirming the readiness and effectiveness of the technology. The success of these trials marks a significant step forward in exploring the possibilities of integrating ANT Machines' electric heavy-duty robots into port operations, with promising implications for the future of intralogistics.

Next Steps and Future Measures of Success

The next step is to use the learnings of the project to upgrade the tested prototype to prepare it for an operational pilot project in the Port of Tyne to increase the TRL of the solution.

This could be done with funding support of the Freight Innovation Fund programme It will be a logical continuation of the TRIG project which allowed to collect valuable data on the technology application in a port environment. It also enhanced cooperation within the scientific community involved in decarbonization related issues and raised interest from other commercial stakeholders in the UK and the EU.

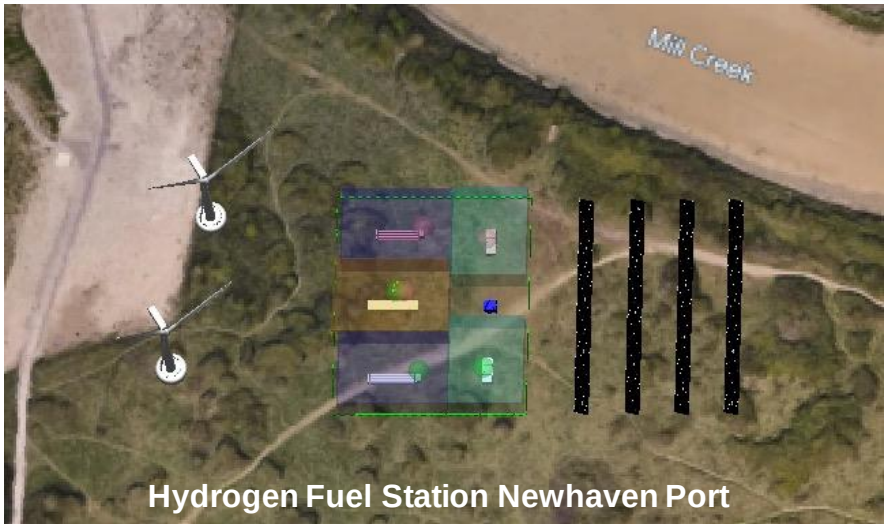
STEAMOLOGY ®
zero emission power solutions

Maritime Decarbonisation

Project Summary

Steamology zero emission power turbines deliver a 'drop –in' diesel engine replacement for marine, rail and industrial applications. Hydrogen technology is inhibited by a lack of fuel production and bunkering at small and medium sized ports.

ZEPB project focus is to research and report on the challenges of small UK ports adoption of bunkering and refuelling infrastructure. Using Newhaven port as a worked example. This FEED study addresses renewable power, electrolysis (Hydrogen production), gas compression, storage, dispensing, regulations, cost capturing and port planning. Using the nearby offshore windfarm work boats activities as the basis for refuelling.



Hydrogen Fuel Station Newhaven Port

Project Achievements

This project directly addresses the Maritime Decarbonisation challenge. The main focus to understand decarbonisation of small/medium sized ports. Working in collaboration with Newhaven port, an example of a multi-modal organisation. The port is heavily reliant on internal combustion engines and infrastructure for their vessels. The project enabled a worked example to give solutions to a sustainable, clean and green, zero emission alternative. The main achievement has been the increased understanding of current hydrogen infrastructure technology. This has resulted in a large data base of suppliers and manufactures for each of the fuelling components, required to build a marine hydrogen fuel station. Extensive design work of two different hydrogen 3D CAD models were undertaken, using two potential sites at Newhaven. Steamology has developed connections with the offshore wind industry and Crew Transfer Vessel (CTV) operators. These important business connections will be developed in future pilot scale projects.

Conclusions

The technology supporting the fuel production and storage of hydrogen is rapidly developing. While it's shown the capital and operational expenses are high, with long manufacturing lead times. Hydrogen demand is increasing, many companies are entering the supply chain, with improved efficiency and cost effectiveness. The main output resulted in Steamology to developing a full turn key technical/commercial model. The project has been successful, raising the TRL level with an end to end solution.

Next Steps and Future Measures of Success

Steamology, is currently collaborating on a Workboat project to deliver a working quayside bollard pull demonstrator in Q2 2024, using, zero emissions steam generators / turbine and jet propulsion system.

DuoDrive and Offshore Renewable Energy (ORE) Catapult have collaborated with Steamology to study Crew Transfer Vessels for adaption to hydrogen / electric propulsion. Both projects will accelerate Steamology's existing TRL, beneficial for commercialisation prospects. The TRIG project has enabled collaboration with ORE and Newhaven Port & Properties Ltd. Within the supply chain we have worked extensively with company's supplying electrolysis, gas storage/compression, dispensing, certification and regulatory bodies.

Further funding opportunities, A4I Innovations round 9 is ongoing, A4I round 10 is at stage 2. Submissions include A4I round 11. An application for CMDC4 strand 3 is currently being drafted. The upcoming Industrial Energy Transformation Fund (IETF) phase 3 is in scope for zero emission industrial steam and heating applications. Commercial diesel engine replacement or passenger and freight rail applications are progressing.

University of Strathclyde

Project Summary

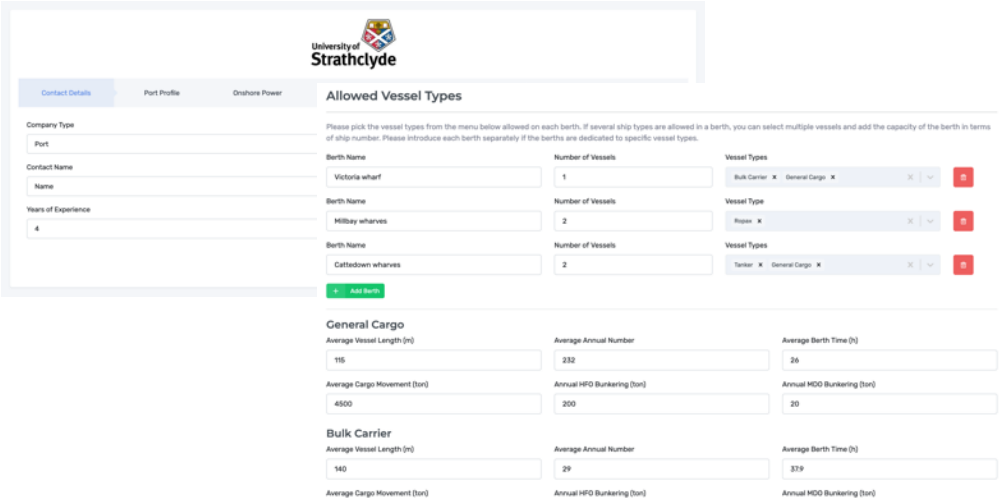
The project addresses an urgent need for sustainable energy solutions in the maritime industry. The decision support tool will enable UK ports to transition towards green energy efficiently and effectively, contributing to the country's efforts to achieve its net-zero emissions target by 2050. A unique energy model has been developed as part of a framework to analyse each port's unique requirements and constraints, taking into consideration the type of activities and location. The tool offers guidance on investments needed to implement green energy solutions, making the transition accessible to ports of all sizes, including non-cargo ports.

Project Achievements

In collaboration with the University of Plymouth, the project focused on developing a decision support tool for the UK Port industry through achieving four main tasks: investigation of ports and marinas, system design and development, commissioning and testing, and upscaling and dissemination.

The project has successfully achieved its primary objective and demonstrated the viability of its concept. At the project's outset, our existing models and framework were at Technology Readiness Level (TRL) 2. Following thorough validation and verification in a real port environment, we are confident that the project has advanced to TRL 5 level. This progress confirms the concept's viability and positions it for further development and delivery. The decision support framework and tool we've developed have undergone rigorous testing, aligning our tool's outputs with real-world and simulation data gathered during prior studies. Currently, the tool is a fully functioning prototype, and in the next phase, the tool will be launched online, enabling us to gather more data and refine the input-output systems.

Moreover, our project has garnered significant interest from industry stakeholders thanks to our effective dissemination efforts. We organised workshops, meetings and engagement events to collect feedback. Several follow-up opportunities are at development opportunities now.



Conclusions

This project has successfully developed a decision support tool in response to these challenges. This tool is designed to aid ports, harbours, and marinas in making short-term, medium-term, and long-term investment decisions, with the ultimate goal of assuming the role of green energy hubs by the year 2050. The project delved into various decarbonisation options, energy sources, and the comprehensive decarbonisation of the freight transport network. It considered the unique characteristics of each port, harbour, or marina, including operational type, size, capacity, location, and more. Overall, this project has convincingly demonstrated that such a decision support tool can be created to facilitate the decarbonisation efforts. The tool is now ready for further testing; initial tests have validated its accuracy.

Next Steps and Future Measures of Success

The project's next phase involves creating a comprehensive solutions database and enhancing the tool's discussions sections. A workshop will be organised for further dissemination, and discussions with industry stakeholders will continue. Additional funding opportunities will be explored to expand the tool's application beyond the UK. Discussions about further funding and collaborations are ongoing, including a Knowledge Transfer Partnership (KTP) and consultancy projects with ports.

Funded by
UK Government

Transport Resilience to Severe Weather and Flooding

Delivered by

CATAPULT
Connected Places

Computational Modelling Cambridge Ltd (CMCL)

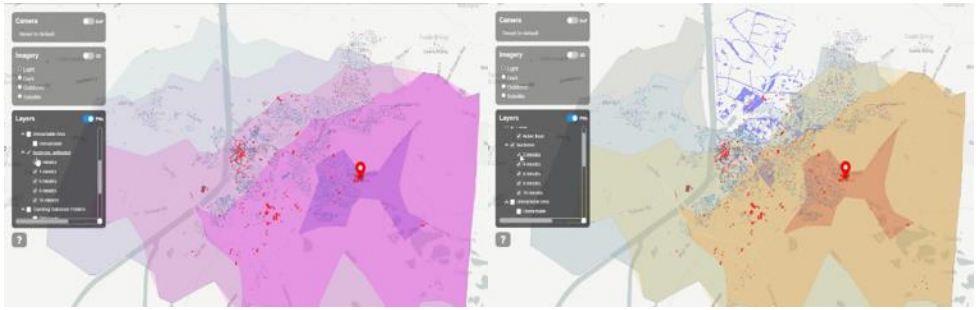
Project Summary

CMCL are contributors to The World Avatar, a digital ecosystem that aims to connect knowledge across sectors to improve the liveability and sustainability of our environment.

CMCL have contributed to the technical development of CReDo, the Climate Resilience Demonstrator. It securely combines cross-sector data from the climate, power, water, telecoms and healthcare sectors through distributed architecture. Feedback from end users included a desire to see whether they could access sites that the tool highlighted as being potentially vulnerable.

The inspiration for this project came from seeing how a lack of interoperability both within the transport sector and across other sectors was hindering innovation.

The World Avatar



A comparison of 2-minute isochrones from a hospital before and after a flood

Project Achievements:

We successfully connected cross-sector datasets, and applied routing agents to answer relevant queries.

We have connected the routing work to the other capabilities within The World Avatar, and have begun identifying potential areas for solution deployment in the future.

We have had valuable engagements with high-level challenge owners, and look forward to building these relationships after the project's conclusion. A particular highlight was a visit from Daniel Zeichner, MP for Cambridge where we could exchange ideas on our work and transport challenges in the local area.

Conclusions:

We have upskilled our internal technical team when developing transport modelling and are exploring new tools to integrate into the digital ecosystem, further boosting its capabilities.

We successfully perceived novel queries, as an initial step towards a complete routing offering as part of The World Avatar ecosystem marketplace.

We learnt valuable lessons surrounding the accessibility of routing and traffic data, and have better positioned ourselves to breakout into this market.

Next Steps and Future Measures of Success

The next steps for us are to build upon this demonstrator and connect with challenge owners across the UK. We are confident that we can leverage our experience across TRIG and other projects to identify challenge owners who would benefit from The World Avatar ecosystem and its new capabilities.

The increased credibility within the Transport sector as a result of this project has been valuable, and we have already had high-level conversations with stakeholders across the country. A measure of success would be via a challenge owner integrating the tool into business-as-usual activities.

We are aiming to initiate a small-scale project with a local government body, and we look forward to exploring opportunities with more groups across the sector.

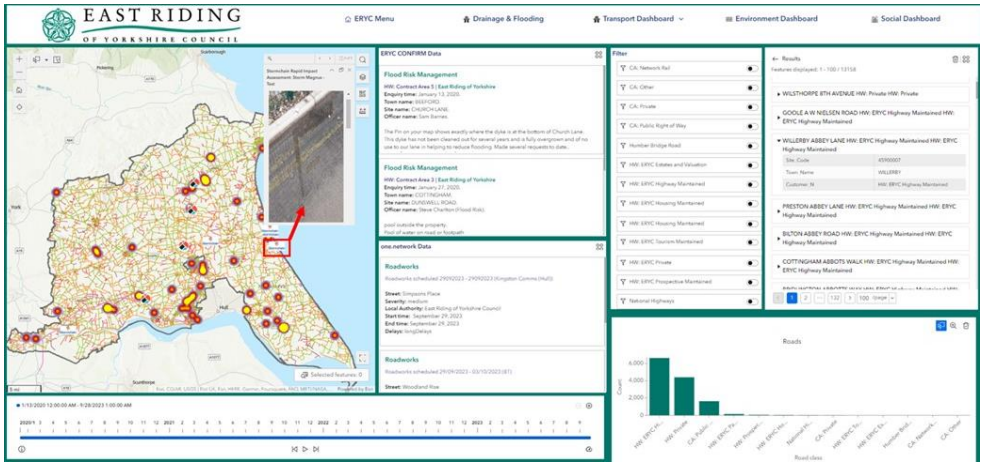
EAST RIDING OF YORKSHIRE COUNCIL

Transport Resilience to Severe Weather and Flooding

East Riding of Yorkshire Council

Project Summary

Situational awareness is an essential component of defensible decision-making during emergencies. The managers of our 'lifeline' highway networks need situational awareness to know what is happening, to understand how that impacts on network functioning, and to calculate what might happen as a result. This project focused on creating a new process and supporting products to underpin Highway Operations Manager's situational awareness during major incidents and emergencies.



Project Achievements

The project focused on the creation of outputs that can directly enhance highway operations managers' ability to manage extreme events and has been successful in achieving this.

The main achievements have been the development and illustration of a structured process, checklist and dashboard, which can guide and supports managers' decision making, even as they experience "their worst day".

Although there were issues with the project's IT element, this was embraced as a key lesson and used as an opportunity for goal realignment, the resulting dashboard is more functional as a result. Collaboration through workshops and focus groups with other authorities has presented opportunities for a substantive cross-fertilisation of good practice to be integrated in project outputs.

Conclusions

The project has successfully created outputs, which if adopted as new sector doctrine, are now available to directly inform and support highway operations managers faced with managing emergencies as part of a coordinated multi-agency response. In effect, this work has created new tools and drivers to enhance the development of important new sector resilience competencies. These outputs, if broadly accepted and engaged with, offer the potential for the sector to enhance its status as an empowered emergency responder and as the recognised lead in the management of the nation's critical lifeline highway infrastructure.

Next Steps and Future Measures of Success

This project has never been about the commercialisation of a product. Rather, it has always been focused on developing a greater resilience culture within the highway sector through the creation of outputs that can be used to directly strengthen and support practitioner competencies in preparing for, responding to, and recovering from major incidents. Next steps will start by embedding the newly defined processes within the operational practice of East Riding Council and the wider highways community through training and exercising. One way to increase the outputs relevance could be to translate them into complementary checklists for use by other members of the team (e.g., strategic lead, operational team leader).

Iterative work to develop the all-hazards dashboard will continue, to ensure the integration of any new and useful technological capabilities (e.g., bridge telemetry).

Further engagement with like minds in Cumbria and Dumfries & Galloway offers the potential for a sector leading resilience collaboration.

TRIG support has been invaluable as it has provided a level of legitimacy to the project that makes adoption of the outputs by the sector more likely.

Imperial College London

Project Summary

70% of weather-related accidents occur on wet pavements, which is a key safety concern. A next-generation permeable concrete pavement (Kiacrete, Fig. 1) has been developed to deliver a stormwater-free, durable and sustainable pavement surface for transportation infrastructure. This project measured the slip and skid resistance of Kiacrete in the laboratory and compared against traditional impermeable concrete surfaces, showing excellent performance. The ability to use pigments to change the surface colour of Kiacrete has also been explored and has been demonstrated that colours suitable for different transportation applications can be achieved. Kiacrete can mitigate against the climate change related extreme weather and improve transport users' experience by ensuring a safe, reliable and inclusive network.

Fig. 1. White City proof-of-concept Kiacrete field site.

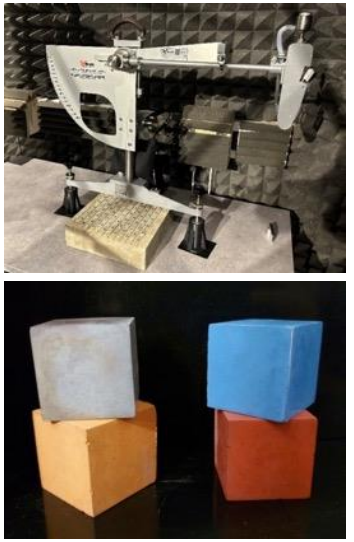


Fig. 2. *Top: British Pendulum Test on a grooved Kiacrete sample, Bottom: Pigmented cementitious samples for different transportation applications.*

Project Achievements

The skid resistance properties of Kiacrete were measured using the British Pendulum Test. Laboratory samples were prepared for Kiacrete and conventional impermeable concrete with different surface finishes, and were tested in dry and wet conditions (Fig. 2). The skid resistance of Kiacrete was measured to be suitable for pedestrian and vehicular applications in both dry and wet conditions for all surface finishes tested. The wet condition skid resistance of Kiacrete was observed to be significantly improved over conventional impermeable concrete, demonstrating the benefit that Kiacrete has in enhancing transportation user safety over traditional paving surfaces.

Pigmented cementitious samples were prepared with varying concentrations in the laboratory. The surface colours, for different concentrations and combinations, were measured using a spectrophotometer to determine the feasibility of achieving suitable surface colours for transportation applications through pigmentation, compared to the more commonplace surface painting. The effect of the pigments' concentration on the workability and compressive strength was also measured. The tests have demonstrated that Kiacrete can be produced with suitable surface colour (Fig. 2), workability and compressive strength for a range of transportation applications.

Conclusions

We have developed a puddle-free permeable concrete pavement (Kiacrete) that addresses the challenges of the conventional permeable pavements and can replace traditional impermeable paving surfaces. This project has been successful in demonstrating in the laboratory that Kiacrete's skid resistance in both simulated wet and dry conditions is excellent and superior to impermeable concrete surfaces in wet conditions. We have also shown that it is possible to produce a pigmented concrete surface that can achieve colours suitable for a wide variety of transportation applications. Kiacrete can mitigate against the harmful effects of climate change and improve transport users' experience by ensuring a safe, reliable and inclusive network.

Next Steps and Future Measures of Success

This project has advanced Kiacrete from TRL 3 to 5. The slip and skid resistance has been verified in the laboratory and there is a need for the large-scale real-world performance to be verified. Following these developments Kiacrete can then be deployed across the urban environment and the transportation sector to deliver safe, resilient, sustainable and puddle-free pavement surfaces.

Sheffield Tribology Services

Project Summary

The deciduous leaf fall and wet weather during the autumn season causes very low friction between railway wheel and rail. Lack of measurement equipment means that it is difficult to determine where the low adhesion areas are and whether cleaning or treatment has been effective. Equipment that exists is fragile, expensive and complicated. STS are developing a new friction measurement tool designed for widespread industry adoption to assess track condition.

Project Achievements

Design and development of a modular tribometer.
A demonstrator was build, using a more portable piece of steel rather than a full sized rail, and successfully demonstrated to the Adhesion Research Group.
Engagement with key future customer base from rail industry
Feedback from these was obtained, some integrated into the development during this project (eg tribometer mounting onto rail, re-designed and now able to measure gauge corner as well as railhead). Others added to technology roadmap for future.
Live testing of handheld product on heritage railway lines.
Data has begun to be analysed to ensure measurement validity.
Started the Network Rail product acceptance process.
Technology roadmap and commercialisation plan for future.

Conclusions

The modular tribometer was designed, built and tested. The concept has been proved in trials and this can be used for further larger scale trials if future funding bids are successful. A commercialisation plan and technology roadmap has been created. Future work has been secured using the device to assess the performance of novel rail cleaning technologies. We learned about different use cases that would benefit the rail industry and re-designed accordingly.

We will continue developing this prototype into a product so that it can be used by the rail industry to prevent damage, reduce delays and improve safety.

Next Steps and Future Measures of Success

We will be carrying out live testing of the product on Network Rail Infrastructure and working towards NwR product acceptance
TRIG has provided both the funding for the development of this technology and the connections for industry engagement. This has accelerated our product development time.
We have had future customers get in contact from both the UK and internationally. Although we are not ready to sell our device as a finished product yet, we have taken on consultancy work as a revenue stream over the next 6 months.
We would like to apply for further funding for integration of additional device functionality and nationwide trials. We have applied to an InnovateUK programme and will also look out for any other potential opportunities.

Slingshot Simulations

Project Summary

Using 2015 Storm Eva as a use case, the STORM (Supporting TranspOrt Resilience with Modelling) Digital Twin project successfully demonstrated that transport resilience to severe weather and flooding can be improved by a digital place-based decision intelligence solution that:

- Integrates disconnected data (traffic, environmental, socio economic, land and building use)
- Links siloed domain specific simulations (transport, hydrological)
- Is easy to use by non-data or modelling and simulation experts

The solution empowers users to rapidly assess flood scenarios and delivers a capability where the impact of "what-if?" future climate events on the transport network can be rapidly simulated and assessed.

Project Achievements

The STORM digital twin project provided a wide range of insights related to transport resilience due to climate. These included, but were not limited to:

- Rapid Identification of Transport Problem Areas Due to Displacement
- Vulnerable Property & People Identification
- Predicted Impact on Relative Emissions Due to Displacement and Rerouting

The project enabled the solution to progress from concept to a commercially available capability embedded in Slingshot Simulations Compass: Engine™ place-based decision intelligence product. By collaborating with Goleyo (transport modelling experts) and Leeds City Council (proxy customer) the solution captures best practices and addresses an end customer defined problem with scalable applicability locally, regionally and nationally.

Conclusions

The STORM Digital Twin project successfully demonstrated the ability for a digital, place-based decision intelligence solution to support the faster, lower cost development of a more climate resilient transport network and do so in a holistic, more equitable way and in context of other critical initiatives such as net zero and the energy transition.

The project also highlighted the opportunity for the UK to take a global leadership position in the development and application of digital place-based decision intelligence solutions and has directly contributed to the commercial business pipeline development for a high-tech software company based in the north of England.

Challenges to the accelerated adoption of innovative digital solutions in a public sector context remain and the ongoing support of Connected Places Catapult, DfT and others is critical if we are to deliver the pace of change climate change demands.

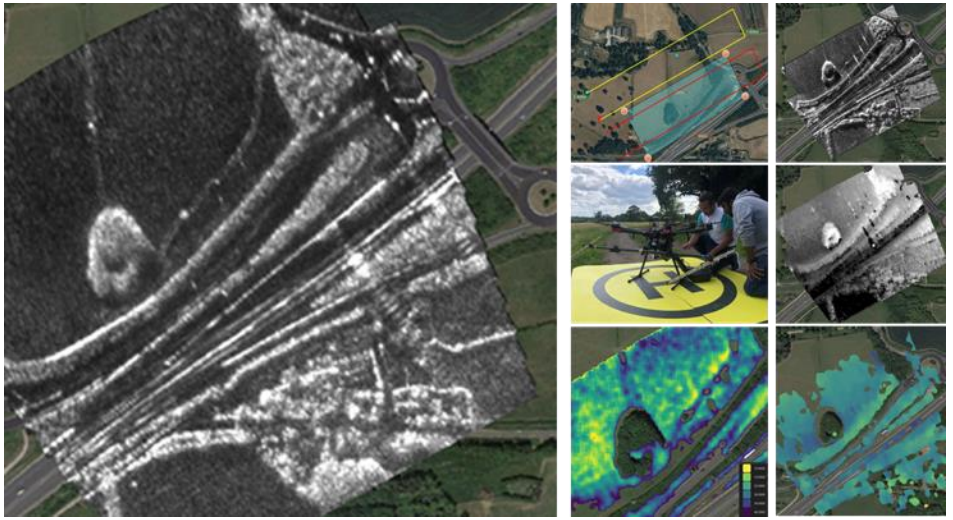
Next Steps and Future Measures of Success

Continued development of the released capability is planned and this includes API based integration with a wider range of environmental impact simulation tools and "real time" traffic sensor data. Future measures of success include commercial business pipeline development and commercial adoption of the solution, along with end user driven use cases to shape and prioritise the development roadmap and release plan. The TRIG22 project has enabled the acceleration of the capability from concept to commercial product. Post project completion steps include the development of sales and marketing collateral and a marketing campaign based on these materials. Slingshot Simulations would like to place on record our sincere gratitude to the TRIG22 stakeholders and cohort members for this opportunity.

Surveyar Ltd

Project Summary

The project set out to determine if drone-borne multiband Synthetic Aperture Radar (SAR) could be used as a directed survey solution to support the risk assessment of railway embankment slopes as a solution transport resilience to severe weather and flooding.



Project Achievements

The project focussed on the integration of multiband synthetic aperture radar sensing with a drone platform, flight control and management to optimise survey, field trials at a number of locations and data processing to achieve an assessment of the soil moisture (a key factor in slope failure).

Key achievements included gaining the first UK Ofcom permit for trial use and application of the technology, first commercial trials of the technology within the UK and first use of the technology within a network rail railway embankment site.

The project was successful in undertaking multiple field trials at three separate locations, including with Network Rail. The outcome of the trials clearly indicated reasonable assessment of soil moisture with reference to ground truthing. The complex nature of the technology and data will require a range of further tests and trials to build data, credibility and workflow.

Collaboration was extended to include soil science components with Cranfield University, SAR interpretation and workflow with Stirling University and optimising flight integration with Radaz.

Conclusions

The project was particularly successful in integrating and testing an emerging technology as well as demonstrating how this can be used and applied to support transport resilience to severe weather and flooding, particularly with respect to railway embankment slope risk assessment.

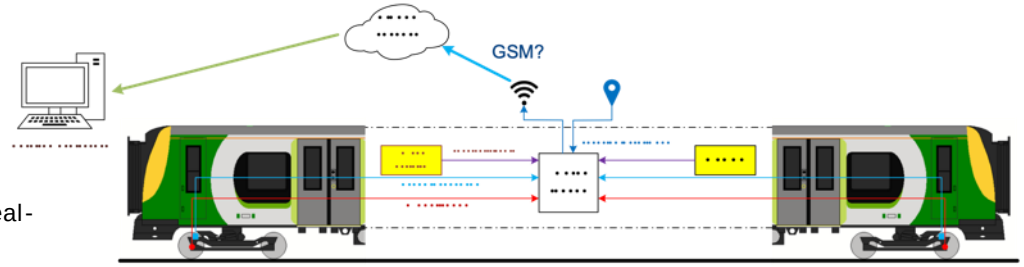
The field trials demonstrated that it is possible to survey and assess soil moisture and map this to support slope stability risk assessment. The field trial data also highlighted outcomes of topography, biomass/vegetation and unconformities (man-made objects etc) are factors which can also impact slope risk.

Next Steps and Future Measures of Success

The research has achieved its proof of concept and has met the core project objectives, demonstrated in a live field environment. The next key steps are to undertake further field trial work to assess repeatability, determine limitations and optimise workflow to provide credibility and viability to a commercial market. The technology has already been funded for a further stage of field trials in collaboration with Cranfield University with a sequence of further use research in application stage. We would hope that the work can be extended with Network Rail with a more detailed assessment of the outcomes with a range of ground truthed field sites where slope stability is an issue.

University of HUDDERSFIELD
Inspiring global professionals

Institute of Railway Research (IRR) – University of Huddersfield



The project developed a novel low adhesion measurement system that can provide real-time estimation of wheel-rail adhesion using on train measurement data. The system measures the actual adhesion level using the fundamental laws of mechanics (wheel acceleration and brake force/torque) and linking this to the adhesion available. Enhancing the train brake performance and improving safety in varying weather conditions, making rail transportation more reliable, reducing journey delays, and improving the user experience.

Project Achievements

- Project focused on the development of an end-user product for the improvement of train brake performance and safety
- The concept has been initially developed to estimate (in simulation) the adhesion more accurately at each wheelset using data collected during the variable sander trial project (funded by the Rail Safety and Standards Board (RSSB)).
- Laboratory testing trails took place, a structured test plan was developed which involved using a paper tape to simulate low adhesion.
- Testing was carried out using the IRRs HAROLD (Huddersfield Adhesion and Rolling Contact Dynamics) test rig.
- Testing has shown that the developed system can provide a reliable estimation of the real-time adhesion conditions when compared to a post processing method.
- The solution was first developed using a real-time PC in-line with MATLAB Simulink, following this it has been converted to an embedded system model allowing for the development of fully functional prototype of the end-user product.

Conclusions

- Using the on train available data, the project results demonstrated the ability to estimate adhesion in real-time using the fundamental laws of mechanics.
- A prototype of the end-user solution has also been developed that allows the product to be placed in a driver's cab or on-train equipment cabinet. It has been designed with a simple interface giving drivers a visual indication which provides real-time understanding of the local adhesion conditions.
- The prototype also provides outputs which allow detailed real-time adhesion data to be streamed either to the train's own brake system, allowing it to optimise the braking control for the conditions encountered, or to a central server.
- This data has a range of uses from providing adhesion data to other trains, planning, and measuring the effectiveness of railhead treatment and other mitigations and improving and validating low adhesion forecasts.

Next Steps and Future Measures of Success

The next steps for this project are:

1. Work with potential customers/funders to seek funding for a limited trial (one train)
2. Work with approvals bodies to determine the necessary system requirements (e.g., Network Rail, rolling stock designated bodies etc.)
3. Work with market and funders to arrange an in-service trial and develop data aggregation / distribution system.
4. Sign appropriate licensing agreements to allow for the system to go to market (The University will support commercialisation)

Funded by
UK Government

The Future of Freight

Delivered by

CATAPULT
Connected Places

ENSEMBLE ANALYTICS

The Future of Freight

Ensemble Analytics

Project Summary

Our project aimed to provide strategic w orkforce planning software for ports, addressing challenges of skill shortages, an ageing w orkforce, and enhancing industry attractiveness. Through flexible digital contracts and a demand simulation interface, ports can proactively hire and train employees using adjusted shift demands based on historical data. This empow ers ports to optimize w orkforce allocation for different cargoes, improve operational efficiency, and employee contracts. The software offers insights into w orking structures appealing to the younger generation, making the port industry a more enticing career choice. Overall, our project aimed to enhance port operations, mitigate skill shortages, and promote industry grow th.

Project Achievements

Our project focused on creating software to support strategic workforce planning in ports, addressing skill shortages, an aging workforce, and industry attractiveness. Key achievements include: Data Collection and Cleaning, Stakeholder Engagement, Contract Development, Platform Development, and Testing, Technical Viability. Challenges included data cleaning due to messy and non-uniform data and the complexity of building constraint model contracts. Our project is considered a success, offering a robust and adaptive software solution for port workforce planning. Reflecting on the process, we acknowledge the importance of preliminary data assessment and domain-specific consultations in complex industries like maritime.

Conclusions

The project successfully developed software to aid ports in strategic workforce planning, addressing skill shortages, an aging workforce, and industry appeal. The software enables workforce simulation under various conditions based on historical shift data, contributing to improved employee work structures.

Challenges included data cleaning, but stakeholder engagement, especially with Bristol Port Company, proved invaluable.

The project's outputs demonstrate the software's potential to enhance operations and foster constructive discussions between port authorities and labour unions.

Valuable learnings emphasize the importance of preliminary data assessment and domain-specific consultations in complex industries like maritime. The project's success lays the foundation for commercialization and further expansion.

Next Steps and Future Measures of Success

Commercialisation: Our immediate focus is transitioning from research to a commercially viable solution. This involves refini ng the product to meet maritime sector needs, particularly during union negotiations, where it can transparently showcase workforce requirements and operational insights.

Integration with Existing Systems: We plan to integrate our tool with our existing scheduling product, offering a comprehensive solution for both immediate and long-term workforce and operational needs.

Expansion to Other Markets: Our product's versatility extends beyond ports, as evidenced by contracts with Boskalis and a Letter of Intent from Van Oord for offshore and dredging markets.

Progress on the Technology: Readiness Level (TRL) Path Commercialization will elevate our product from TRL 5 to TRL 6. We aim to achieve TRL 6 with Boskalis by year-end and with ports by end of 2023.

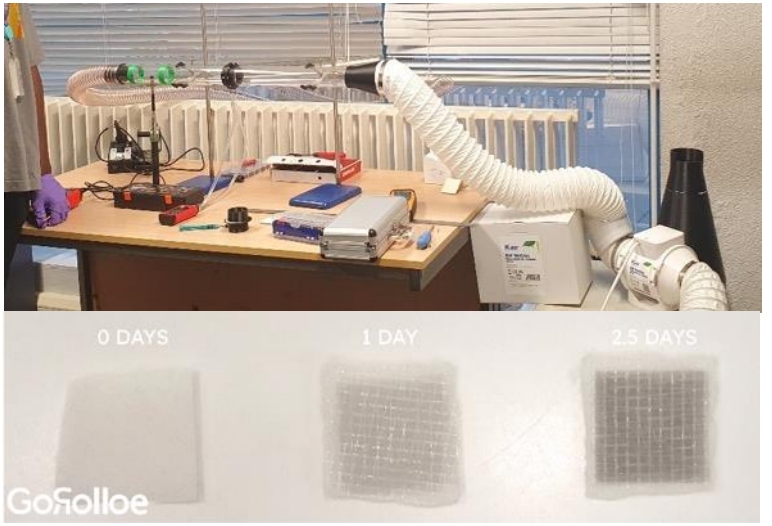
Collaborations and Commercial Interest: Collaborations with Boskalis and Van Oord showcase commercial potential. We'll continue seeking partnerships and feedback to enhance our offering.

Funding and Future Plans: To further develop and scale, we're actively exploring investment opportunities from stakeholders w ho recognize our solution's value in the maritime industry.

GoRolloe

Project Summary

GoRolloe's TRIG project was centred around developing a non-exhaust emission capturing hardware device to operate within the (twin) wheels of HGVs and buses. The goal of the project was to take the technology from TRL2 (concept, ideation, research, tests, basic models) to TRL4 where it is validated within a laboratory environment. To do this, our team of engineers and scientists conducted research, engineering development and scientific experiments.



Project Achievements

The project focus was to validate our technology through showing the product adapts to vehicles in a functional and safe manner, is efficient at capturing non-exhaust emissions, does not cause harmful side-effects to the vehicle, and has commercial traction.

The project concluded with a demonstrator validated in lab environment, airflow and filtering know-how, scientific reports, and commercial partnerships.

We have established a commercial partnership with a Tier 1 manufacturer in the automotive sector and an established filter material manufacturer with expertise in the automotive field.

Conclusions

The project was very successful, bringing our technology from a concept to a lab validated demonstrator with commercial interest. Understanding the engineering and commercial constraints was key to building a product that stood a chance to be adopted by the automotive industry. We are now at a stage where our proof-of-concept is ready to be patented and pilot trialled in a real operational environment. The project also enabled us to gain connections and know-how which will accelerate our development of the technology onto other vehicles in the next coming years.

Next Steps and Future Measures of Success

- Trial prototypes on industrial testing rigs, at testing centres, and on roads with OEMS to test functionality, safety, assembly, and efficiency
- Assess OEM interest and gather commercial feedback from pilot trials; understand competitive landscape and where we stand in comparison
- Keep up with Eu 7 developments to foresee if it will be adopted and what will be the requirements
- Showcase our technology next autumn for the first time.

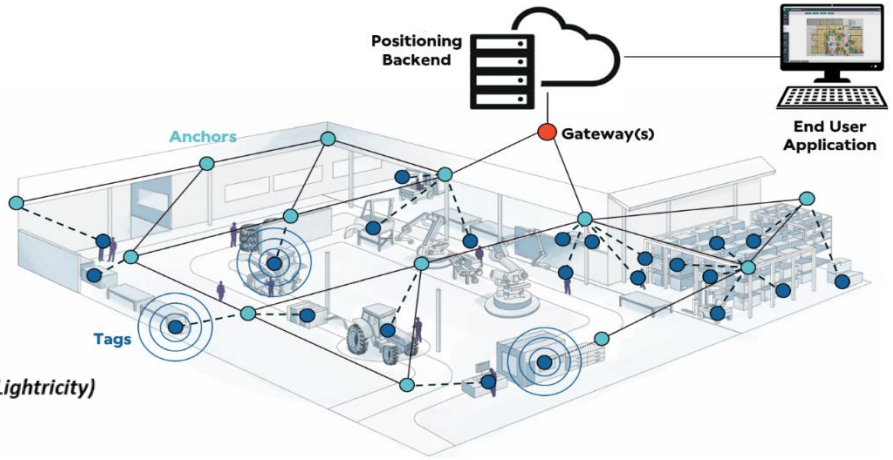
Lightricity Ltd

Project Summary

This project addressed the Future of Freight challenge by developing light-powered wireless mesh freight tracking for cross-modal outdoor and indoor use, a novel approach that removes scalability and sustainability barriers of existing battery-powered solutions. Tracking of goods is essential to optimise operational efficiency of freight and logistics systems and to improve customer experience. Benefits include reducing traffic congestion, lowering carbon emissions of transport and thereby improving air quality.

This project investigated the feasibility of light-powered (usage of sustainable energy source) wireless mesh asset tracking for cross-modal outdoor and indoor use, making the whole hardware architecture battery and wired-power free.

Self-powered BLE tag (Lightricity)



Project Achievements

Notable innovations and results from this project: 1. proprietary battery-less energy harvesting architecture with back-up storage covering bridge periods of darkness; 2. PV cell-integrated light concentrating micro-optics; 3. retrofittable, miniaturised PCB and enclosures for ceiling-mounted (under light fixtures) and asset-mounted devices.

These results enable multi-purpose, battery-free mesh networks that are simultaneously applicable to tracking, wayfinding and building sensor systems.

When fully productised, the project innovations will enable the majority of network infrastructure to avoid battery or mains power.

Conclusions

This project developed and demonstrated highly innovative power options to enable the practical, maintenance-free and sustainable deployment of mesh IoT network topologies for applications such as asset tracking, sensing and wayfinding. This is beyond the state of the art where battery and mains power are major constraints on deployment.

Having reached TRL 4, further technology development will pave the way for us to offer companies nationally and internationally a self-powered mesh hardware solution for incorporation in their own solutions and services.

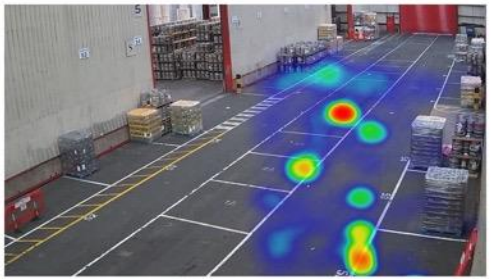
Next Steps and Future Measures of Success

Post-project demonstration to end-users are planned, to ultimately enable us to enter the supply chain as a tracking hardware supplier for a wide range of transport applications. Our post-project route to market and commercialisation plans are: 1) develop production prototype (Q4/2023-Q1/2024); 2) scale up from prototype manufacturing to volume; 3) production process (Q2/2024-Q4/2024); 4) customer trials (Q3/2024-Q1/2025); 5) set up production and test facilities (Q1/2025—Q3/2025); 6) first volume commercial deployments and exploitation (Q3/2025-onwards).
We are in discussions with two potential organisations (under NDA) who expressed an interest in trialling our light-powered mesh solution with their customers.

RoboK

Project Summary

Our project focused on revolutionising the logistics industry by developing a scalable, intermodal AI-powered logistics monitoring solution. Powered by AI-based computer vision and federated learning, our aim was to enhance transparency, efficiency, and sustainability throughout the supply chain, aligning with the Department for Transport's (DfT) priorities. In this project, we worked with data sources from different ports and explored the potential of creating a robust AI solution with best-in-class accuracy for the maritime industry as well as linking to the wider logistics industry across transport modality.



AI models trained on diverse, multi-site dataset for robustness and scalability

Project Achievements

In summary, our project successfully developed a cutting-edge logistics monitoring solution that aligned with DfT priorities, promoting economic growth and increasing global impact, positing UK as a global leader in utilising AI for the transport and logistics industry. Key achievements include technical viability, data privacy, and security, while notable activities involved real-world data processing and collaborative efforts with industry experts and stakeholders that RoboK would not have had the opportunity to engage with. This project represents a significant step forward in addressing critical challenges in the logistics sector while embracing technology and inclusivity.

Conclusions

In conclusion, our project successfully proved the concept and generated valuable outputs on the ability to using diverse dataset to improve robustness of AI solutions that have the potential to transform the logistics industry. The project not only achieved its primary objectives but also provided critical learnings about the technical feasibility, privacy, security, and change management aspects of technology adoption in logistics. We gained confidence in producing industry-specific models that have wide applicability, These insights will guide future developments and the broader adoption of technology-driven solutions in the sector.

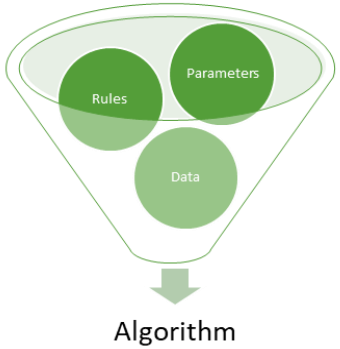
Next Steps and Future Measures of Success

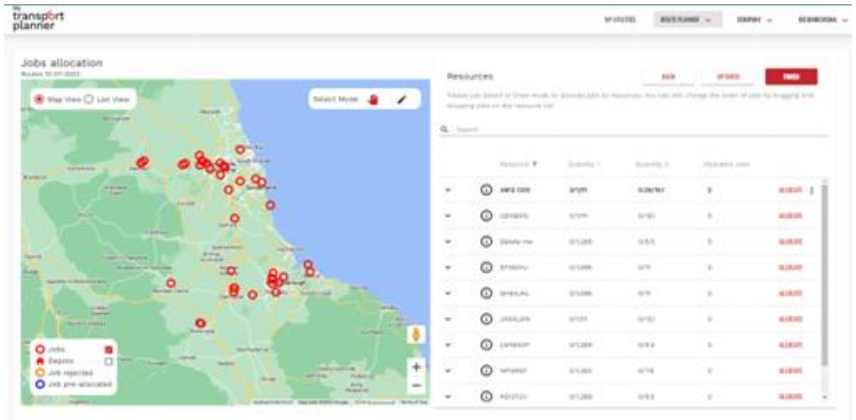
The immediate next steps for our project involve expanding live testing in diverse logistics environments to gather more data and fine-tune the solution based on real-world feedback. We are actively pursuing collaborations with logistics partners and technology providers to ensure successful integration and deployment. Engaging with interested commercial customers is a priority, aiming to tailor our solution to their specific needs and explore potential partnerships. Securing additional funding is crucial to support the scaling, marketing, and widespread adoption of our solution.

The Algorithm People Ltd

Project Summary

The project simulated an existing wireframe concept integrating new transport-related technologies and IT into a delivery and collection network focusing on food service, grocery and parcel deliveries for businesses and consumers. The proposed network converges urban consolidation hubs (HGV to LGV transfers) with a high density of micro-hubs that provide “super local” secure and automated collection and returns locations (Click&Collect) intermodal transfer locations (LGV to Cargo bikes). The deliverables included an evaluation of sustainability, business model viability and sustainability.





Project Achievements

The outcomes of our project directly address DfT's priorities

- Capital investment, recruitment and service provision at local level >> benefits local economy
- Agnostic, edge of city consolidation hubs >> intermodal transfer from diesel HGV's to LCVs supporting LEZ/ULEZ compliance; HGV operation on SRN not LTN, quick turnarounds and return loads, improving fill rates and efficiency
- Outcomes & IP are globally exportable

Conclusions

We have demonstrated potential mileage and emissions savings through specific combinations of freight consolidation spanning inbound supermarket roll cage deliveries, pallet networks and parcel deliveries using vans and last mile cargo bikes, in tandem with existing freight hubs and Click & Collect hubs.

Hubl's CoolRun roll cages remove all transport refrigeration emissions, increase vehicle payloads, supports fleet electrification, inbound & outbound goods, ambient & chilled in same non-refrigerated vehicle.

The Algorithm People's AI-driven algorithms and machine learning capabilities were demonstrated to improve delivery efficiencies by >20%. There is potential to double this with additional consolidated freight, mobile hub & CoolRun features.

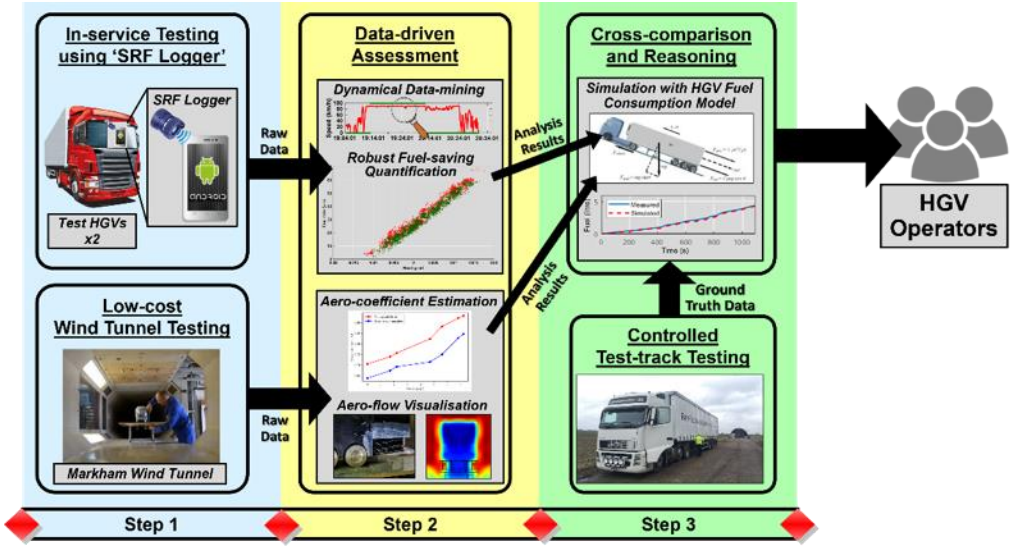
Next Steps and Future Measures of Success

Having established a variety of key operating parameters and constraints, The Algorithm People would be open to utilising this knowledge to support a consortium of operators who would be interested in carrying out a real-world trial. We have demonstrated that The Algorithm People’s advanced AI algorithms are capable of optimising routing and sequencing plans for delivery of consolidated freight across a number of collaborating operators, which would place us at TRL level 5 or 6.

The University of Cambridge

Project Summary

This project concerns developing and validating a novel data-driven approach to assessing carbon-saving benefit of decarbonisation interventions to Heavy Goods Vehicles (HGVs). The approach avoids the long-time in-service trials currently practised by HGV fleet operators and excludes the uncertainty caused by a variety of operating factors such as, driver behaviour, payload, road elevation, weather, traffic etc. The approach was validated using independent controlled wind tunnel experiments and test-track experiments. The proposed approach can help accelerate the decision-making of HGV fleet operators regarding the adoption and deployment of decarbonisation interventions.



Project Achievements

The data-driven assessment approach developed and validated from this project takes advantage of the high-resolution HGV operations data provided by the vehicle Fleet Management System (FMS) interface, and features mining for dynamically comparable driving conditions from real-world HGV operations while excluding the influence of various operational factors that have been confounding conventional analysis.

In this project, the fuel-saving benefit of an optimised cab deflector design was quantified by using the proposed data-driven approach to the high-resolution data collected from the two HGVs during their real-world operations over a period of 3 months. One of the two HGVs were fitted with the optimised cab deflector of interest whilst the other with a default (baseline) cab deflector. These two HGVs were also experimented in a controlled environment on a test track. Results derived from the controlled experimental measurement were found agreeing very well to those obtained from the real-world analysis using the proposed data-driven approach.

Conclusions

A 3.8 to 6.6% fuel-saving benefit of the optimised cab deflector, compared to the baseline deflector was identified in the motorway driving condition under a vehicle weight of 32 t, through applying the proposed data-driven assessment approach to the high-resolution in-service data. The controlled experiment results showed that the HGV with the optimised cab deflector enjoys a reduction of aerodynamic drag by 11.69%, which suggests a 5.6% fuel saving for an HGV of the same weight and in the same motorway driving condition. The fuel-saving results obtained from the two independent analysis matched very well.

Next Steps and Future Measures of Success

Two tasks are expected to be carried out in the next stage. The first involves extensively validating the data-driven approach developed from this project across a variety of HGV decarbonisation interventions. The second involves establishing a university spin-out focusing on exploiting the data-driven approach and selling a minimum viable (MVP) software toolkit that supports HGV fleet operators' decarbonisation initiatives through proving timely, accurate and reliable assessment of carbon saving analysis.

Funded by
UK Government

Local Transport Decarbonisation

Delivered by

CATAPULT
Connected Places

Aegis

Project Summary

Surrounding environments are increasingly afflicted with elevated levels of particulate matter (PM) pollution. The most concerning is fine particulate matter, known as PM2.5, which presents significant health threats.

Our project's core ambition was to progress a groundbreaking microalgae-based technology from TRL2 to TRL 4/5, tailored to cleanse the air by specifically targeting PM2.5 and CO_2. Unlike traditional photobioreactors (PBR) used for culturing microalgae, our innovative approach markedly reduces water consumption.

Furthermore, we are committed to trialling this system under authentic conditions to comprehensively gauge its efficiency in filtering and transmuting both PM2.5 and CO_2.

Project Achievements

Centred on the innovative microalgae technology devised by our associate, Syklea, we've successfully engineered a functional air filtration prototype.

This prototype seamlessly integrates their technology and boasts a real-time monitoring system for performance and operational tracking.

Through collaborations with esteemed partners, including EMR, the University of Birmingham, and TfL, we've tested the system in genuine as well as simulated settings.

Additionally, the laboratory-based and data analyses have facilitated the in-depth characterisation of our results.

Conclusions

The endeavour has commendably transformed a nascent technology into a fully functional prototype, rigorously tested across varied scenarios.

Regrettably, the outcomes of our testing and analyses have deviated from our preliminary anticipations.

However, these insights will serve as invaluable cornerstones, steering refinements in the technology for impending advancements.

Next Steps and Future Measures of Success

In collaboration with us, our partner Syklea will persistently refine their technology, endeavouring to unlock the full potential of microalgae.

AEGIS remains committed to devising solutions for air quality, an issue of paramount importance in numerous environments.

Our experience with TRIG has not only afforded us the opportunity to experiment with groundbreaking technology but has also s et us on a trajectory dedicated to addressing this challenge.

Beryl

Project Summary

Beryl's project aim was to provide a proof of concept live dashboard showing impacts/near misses that occur on the streets to identify the majority of cycling incidents that go unreported.

We operate micro mobility systems across the U.K. (13 cities) with over 10,000 vehicles active on-street. Through this project we worked with our in-house firmware engineers to analyse all sensor data available through our smart unit (GNSS, accelerometer, IMU, Dynamo pulses, motor control and speed sensor) and using AI technologies, sought to train models that can recognise a journey that included an accident or near miss.

The project addresses the local transport decarbonisation challenge to make targeted improvements to highway facilities to encourage cycling trips, removing significant polluting vehicle trips from our roads.

Project Achievements

1. Undertake firmware engineering in order to analyse sensor data that is available to us through our smart unit technology.
2. Develop the firmware data to extract and communicate that information back to our cloud-based systems.
3. Undertake software/database engineering to store this data in a coherent way so that it can be analysed by ourselves and/or third parties (AI technologies)
4. Train models to identify these incidents in the context of all the other data (making it more likely to be accurate).
5. Data dashboards, summarising and accident and near miss data drafted and shared with transport and local authority partners. Dashboards finalised after discussions with transport and local authority partners

Conclusions

The project has allowed Beryl to kickstart a core business objective of improving safety for our riders and influencing infrastructure decisions for all road users. Dedicating time and resources to this project has allowed us to broaden our knowledge of current data capture and learn the complexities of training AI models.

Successful in developing concepts and making milestones that have taken similar projects years to reach, with a dedicated roadmap to bringing the concept to local authorities within the next 12 months.

Next Steps and Future Measures of Success

- Designing architecture for incident detection and follow-up flow.
- Implementing rider incident follow-up flow
- Active rider incident form to rider journeys which involved an incident
- Roll out sample fleet on 50 bikes to train AI models
- Over-the-air updates to all vehicles

We have received strong interest and began collaborating with our council partners (Norwich, BCP and Brighton) on current methods of reporting accidents to identify the gaps our project will look to fulfil. Becoming a part of council policy looking forward and enabling them to unlock further funding for projects.

Moving forward this improvement to our smart IoT unit will be available to all future partners and will enable more cities in the U.K. and worldwide to benefit from this data. This improvement will enhance our capability to remain a market leader in micro mobility services in the U.K. and will also act as a differentiator as we look to expand our service to Europe and the US over the next 1-2 years. The tendering process that we have to undertake to win new contracts (new cities / regions) has a heavy emphasis on safety and these improvements will enable us to compete favourably and win more contracts in the U.K. and EU / US.

Better Bicycles Ltd

BRIEFBIKE – A BETTER E-BIKE FOR CITY TRANSPORT

Project Summary

We aim to my cycling more convenient than driving for every urban journey.

Our vision is a bike that folds instantly and effortlessly, much like an umbrella, as easy to walk with as a roller case, stores flat against a wall, and with integrated cargo options that don't affect the ability to move easily with the folded package.

Project Achievements

We had previously demonstrated and patented our innovative folding mechanism that unfolds in just half a second. This project initially focused on using mechanism optimization to make the fold more compact, while also improving the handling and adjustability of the bike. This work was very successful; the folded package is now within the 700x500x300mm standard luggage size that allows it to be transported on almost all trains around the world. It is also considerably thinner than the 300mm dimension, making its folded volume less than half of the current best in class on the market.

The design has been styled and a 3D printed demonstrator is being built.

Conclusions

This project has proven the viability of the BriefBike design. This progress has unlocked further funding of £50k from Innovate UK and the demonstrator under construction will be used for presentations to equity investors.

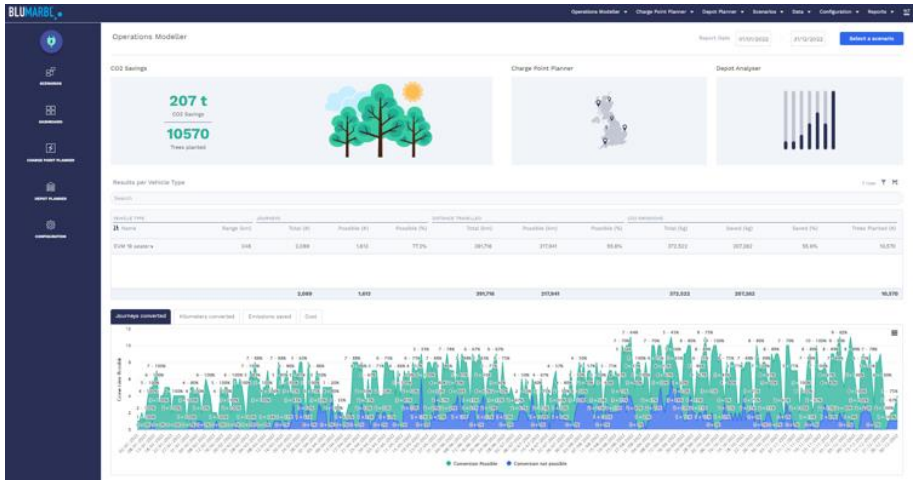
Next Steps and Future Measures of Success

The next step will be to further refine the folding geometry, with ride handling and impact tests completed, and then create a working prototype which can be used for a reward-based crowdfunding product launch. The TRIG program has been vital in de-risking this stage of development.

BluMarbl

Project Summary

Coach travel is a vital and sustainable means of transportation, facilitating access to education, holidays, and combating social exclusion. Despite its eco-friendly reputation, the bus and coach industry contributes 3% of UK domestic transport emissions. Transitioning to Zero Emissions (ZE) is challenging for operators, especially considering the long-term fleet renewal process. The industry, often comprising small, family-owned businesses, lacks resources and knowledge in ZE technology. A place-based approach recognizes the unique challenges faced by different areas in achieving net-zero transport emissions. Our software simplifies complexity for operators, offering data and business models that demonstrate the feasibility of Zero Emission solutions.



Project Achievements

The project focussed on the integration and loading of operator data, creating models to analyse usage patterns with Zero Emission Vehicles (ZEVs), and determining the necessary charging needs.

Thanks to its partnership with Connected Places Catapult and the backing of the Catapult program, BluMarbl gained entry to a substantial dataset from over 10 operators. This dataset was instrumental in testing and enhancing the software, bringing it to market readiness.

During the project BluMarbl engaged in partnerships with electric vehicle manufacturers Yutong and Irizar, alongside battery specialist Zenobe, to aggregate and provide a valuable knowledge resource for coach operators operating in the United Kingdom.

Most notably, this tool has revolutionised the approach by individually modelling each operator, debunking the outdated practice of extrapolating results from a select few larger operators in specific regions. It has levelled the playing field, enabling operators from diverse backgrounds and geographical locations to benefit equally.

This has resulted in our tool being used by 6 operators in Scotland to build the business case to apply for funding to buy 15 electric coaches.

Conclusions

We can proudly affirm that our initiative has successfully come to fruition. The development of our online data verification tool is transforming the landscape of coach operators' transition to zero emissions fleets, making it a more accessible process.

This tool, now TRL 4, empowers coach operators by streamlining the upload and analysis of trip data, telemetry, and vehicle performance metrics. It not only considers historical data but also incorporates route specifics, depot power availability, and data from diverse online sources, enabling the creation of tailored transition plans for every operator.

Next Steps and Future Measures of Success

The next steps are to secure the technical architecture behind the platform so that it can scale up and to tweak performance to ensure customer satisfaction. BluMarbl has signed a revenue generating partnership agreement with Zenobe and is in advanced talks for the same with other financiers and manufacturers. BluMarbl is also talking with the RHA (Road Haulage Association) to see if the toolset can be of interest to their membership. BluMarbl has been approached by several operators in England looking to understand how ZE can work for them and will be looking to engage with them presently. We are aiming for subsidy from ScotZeb2 to further develop an operational side to the platform. We also require funding to host the platform and further leverage the industry data we have collected but the source of this has not been identified yet. The TRIG program me has provided us with useful knowledge in scaling up and contacts with policy makers as well as the opportunity to get to market.

Boundless Mobility

Project Summary

The project set out to use on-board sensors combined with machine learning to capture and report road surface data as well as identify rider behaviour.

The project looked at Local Transport Decarbonisation and more specifically Improving Transport for the User. The project addressed these challenges by demonstrating the ability for the Boundless smart electric bike to identify changing road surface conditions and obstacles such as potholes and speed bumps in real time. Aggregating this data across a fleet of bikes would increase cyclists' awareness of potential dangers and enable local transport authorities to identify areas with poor road surface quality. The project also demonstrated the ability to detect different rider behaviours (e.g. hard braking). This information could be used to train riders on safe cycling as well as inform users, in particular fleet operators, on frequency of predictive maintenance activities.

Project Achievements

The project was divided into three main workstreams:
1. Exploration - We identified viable hardware and software tools.
2. Data collection - We identified the events we wanted to detect, a mix of continuous events (road surface quality), and discrete events (potholes, hard braking, speed bumps). We then collected the data using smartphones with the Sensor Logger application fitted to several bicycles.
3. Machine learning - We classified events, and built a machine learning model using a convolutional neural network. The model classifies events at 87.8% accuracy and we tested this using raw data. The results can be seen in the video here.

Conclusions

- The project successfully demonstrated our ability to use data from bicycles to identify road surface quality and rider events. We successfully moved the project into TRL4.
- We were not able to integrate the hardware directly into the bicycle, but we have furthered our understanding of the existing hardware capabilities, and hardware requirements for a future prototype.
- Being part of the TRIG programme gave us the opportunity to explore this idea further and dedicate resources to do a technical research project alongside developing the business.

Next Steps and Future Measures of Success

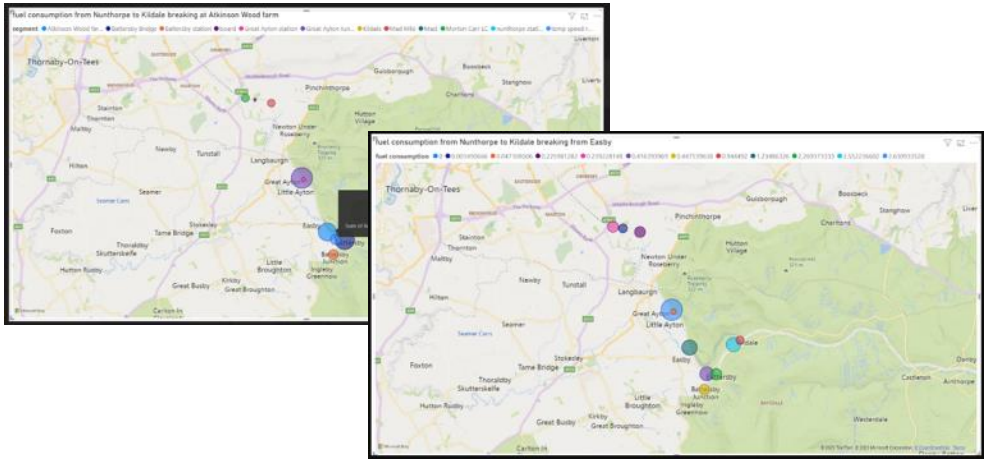
- Increasing our data sample size with an expanded test programme deploying multiple riders.
- And using this to increase accuracy levels to a target of 95%.
- Expand the scope of road surface qualities and rider behaviours we are able to capture.
- Consulting with potential collaborators (e.g. fleet operators, local councils) to understand effective ways of deploying our technology for the benefit of end users).
- Securing follow-on funding to progress beyond TRL4.

Chrome Angel Solutions

Project Summary

The Rail Industry aspires to remove all Diesel trains from the network by 2040. During the transition phase there is an opportunity deliver environmental and economic benefits by making better use of existing data and applying these insights to operational decision making.

This project, focussing on the Local Transport Decarbonisation challenge involved the development of a mathematical model to simulate the operation of a Class 156 train across the Newcastle-Whitby route. Through modelling the complex relationships between the variables which impact train performance, we can calculate the theoretical fuel consumption and subsequent CO_2 emissions related to a specific journey.



Images showing the fuel consumption modelled by different driving styles

Project Achievements

The project provided an opportunity to collaborate with industry partners to experiment and develop this PoC. We actively engaged with potential end users throughout the project to ensure we were always focussed on delivering value and insights that could be of use.
We identified 4 use cases this PoC would specifically focus on as part of the Requirements Specification, and we focussed on ensuring that these produced viable and useful outputs which could be used to explore the next steps and provide further improvements to the model.
The model focussed specifically on a section of route where the Operator is trying to implement improvements. This enabled us to engage with the right people to develop a good understanding of user needs.
We successfully engaged 5 organisations to assist with the delivery of this project, without whom we would not have been able to deliver these results or engage in discussions for next steps.

Conclusions

The project demonstrated it is viable to mathematically model the complex relationships between the variables that define how the train operates and interacts with its environment to calculate estimated fuel consumption and CO_2 emissions.
Further work is required to test and validate thoroughly, but in its current form, it is useful for engaging in discussions supporting operational decision making. E.g. the model illustrated that differing driving styles can have differing fuel consumption and emissions.
A project like this requires collaborative working with Industry representatives, subject matter experts and technical delivery partners to ensure that the outputs are usable and useful.

Next Steps and Future Measures of Success

We are in active discussions to develop the model further with the Train Operating Company. Specifically, there are two new work streams:
1. To expand the use case around Driving Styles by looking at other sections of the route where there is variation in driving style that could impact consumption and emissions
2. To expand the use case around emissions modelling to look at the contribution of different traction types in and around Manchester Victoria Station

We would also like to continue to develop and improve the base model by further testing and validation (with real data) and consulting with subject matter experts to model the variables that we have not yet been able to. The TRIG programme gave us the opportunity to bring together an experienced and diverse team who contributed to this project. This enabled us to bring together expertise, background knowledge and capability to build the modelling tool. Direct engagement with potential end users also meant that we focused our PoC on use cases which had the potential to deliver value as part of this project.

Edge Innovation Ltd

Project Summary

This collaboration programme with Derwent Valley Car Club (DVCC) aimed to research the potential to package learning from rural car clubs to create new and improved processes for other communities.

Using human-centred design to build 'car club in a box' for application in other parts of the UK.

Project Achievements

- The project has researched the key challenges related to transport and mobility in rural areas.
- Involved over 45 hours of engagement with 15 organisations from DfT to local communities.
- Has highlighted a need for alternative transport solutions in rural communities and in some deprived urban locations.
- Created partnerships with communities and local authorities who wish to trail new alternative zero emission solutions yet the lack the knowledge and capacity implement. .
- A new brand has been created and the compiling of the necessary data and support packages to move the concept forward.

Conclusions

This programme has been successful at validating the need for supporting communities with the knowledge, skills and systems to create community car clubs faster and more sustainably. The engagement levels and interest has surpassed expectations and further validates the interest and demand in the area for alternative transport choices in rural communities.

Next Steps and Future Measures of Success

To bring the programme to commercialisation further investment is required into the technological and legal aspects of the so lution.
The TRIG programme has enabled access to new partnerships and direct access to key officials within the Department for Transport. The research has led to a clear and identified need and commitment from communities and local authorities with a number of areas committed to piloting the concept in their area.
We plan now to move to commercialisation by securing funding to develop the technological and legal aspects of the package an d pilot a proof of concept with project stakeholders before moving to full commercialisation.

IONA Logistics Ltd

Our twin projects, funded by Connected Places Catapult, focused on automating key elements of drone logistics: Battery Swap and Parcel Dispatch. The Battery Swap system aimed to enable continuous drone flights by automating battery replacement, overcoming the challenge of limited drone endurance. Concurrently, the Parcel Dispatch project sought to decentralize and automate cargo handling, addressing inefficiencies and emissions in last-mile delivery. Both projects targeted creating a more sustainable, scalable, and efficient logistics network, drastically reducing the industry's carbon footprint and enhancing service accessibility.

Project Achievements

Focus: The project primarily aimed to automate and optimize drone logistics in two key areas: autonomous battery swapping and automated parcel dispatch. The objective was to meet DAL-B aerospace standards, enhancing drone endurance and operational efficiency.

Main Achievements:

- Successfully developed and lab-tested a prototype for automated battery swapping that meets stringent aerospace standards.
- Implemented an autonomous parcel dispatch system to streamline logistics and parcel handling.

Programme Highlights:

- Collaboration with The National Robotarium provided access to a highly skilled talent pool, driving innovation and quality.
- Achieved pinpoint landing accuracy and incorporated weather-resistant structures, thereby elevating the system's efficiency and reliability.
- Introduced AI-driven automated drone inspection to minimize downtime and improve operational performance.

Activities Undertaken:

- Extensive R&D for system design and AI integration.
- Collaborative brainstorming to tackle technical and business constraints.
- Feasibility reports and computer models to validate the approach and inform future development.

Conclusions

The projects successfully proved the feasibility of autonomous battery swapping and parcel dispatch for UAVs, meeting DAL-B aerospace standards. In collaboration with The National Robotarium, we produced feasibility reports and preliminary designs, advancing our aims. We also discovered value in optimising for modular UAV compatibility. The success attracted additional private investment, validating the project's viability and future potential.

Next Steps and Future Measures of Success

The next step is live testing, supported by our recent application to the Connected Places Catapult accelerator and signed LOIs with UK logistics providers for commercial trials. We're actively seeking additional funding from private investors, who've shown increased interest thanks to TRIG's foundational R&D support.

The TRIG programme significantly accelerated our project's journey towards commercialisation and helped attract otherwise risk-averse investors to our hardware start-up.

Lancaster University

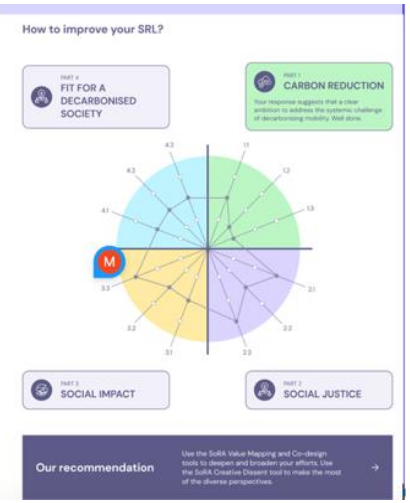
Project Summary

SoRADASH has developed a Societal Readiness Assessment (SoRA) Dashboard for self-assessment of societal readiness levels (SRL) and improvement of the societal readiness of decarbonising transport projects in the UK and internationally. The aim is to increase the quality of decarbonising projects in terms of carbon reduction, social justice, social impact and fit for a decarbonised future, and thereby facilitate appropriation. SoRA is designed to complement and challenge Technology and Market Readiness Assessment.

Project Achievements

SoRA focuses on improving and de-risking efforts to decarbonise transport. The IPCC and the UK Climate Change Commission agree that 40-70% of the green transition need to come from social change. Worldwide £150 trillion has been pledged to tackle carbon emissions, £1.4 trillion in the UK. However, social change is difficult to leverage and many projects fail, often at huge cost. SoRADASH helps funders, investors, local authorities, solution developers, designers, planners, individuals, communities, and researchers to increase the societal readiness of projects designed to decarbonise transport.

Designing SoRADASH through extensive stakeholder engagement and collaborative design is a major achievement of the project. Through involvement of sustainable transport consultants, small and large design and master-planning firms, local authority sustainability officers, Third Sector Groups, youth and community climate advocates, we have enabled greater competitiveness, better products and services, and less risky investment of time and resources. External parties like NESTA have contacted us to discuss SoRA. Researchers at Taiwan's National Yang Ming Chiao Tung University use SoRA in case studies in Taipei and Sydney.



Conclusions

Assuming 27% of the £1.4 trillion pledged for a green transition in the UK is spent to tackle the 27% share of transport emissions, it would seem worthwhile to invest at least 0.1% on increasing the societal readiness of decarbonising transport projects. Leveraging such a social turn needs support through a standard systematic methodology that boosts creativity and social justice. SoRA and SRL are designed to complement and challenge innovation that has, so far, shown an over-reliance on Technology and Market Readiness Assessment, with many costly failures. Investing just 0.1% of investment in developing societal readiness could be transformational.

Next Steps and Future Measures of Success

SoRADASH has already been live tested in the context of pilot projects. Stakeholders have told us that it has proved 'critical for development of better vision-led planning' and 'management of dissent'. It is also 'really good to get really quality output, without spending a heap of money you don't have', it enhances actionability and accountability in terms of social justice and social impact.

To take SoRA to the next level, we need to develop SoRA tools or 'instructables' that are more stand-alone and develop a service-model that can support consultancy. There is also scope for further research on research questions like: How does measurement of societal readiness levels change public procurement of solutions designed to decarbonise transport? We are seeking follow-on funding through a range of different routes, including further research.

The TRIG programme has provided resources for an intense sprint of development form TRL3 to TRL6, access to an amazing network of fellow innovators, and invaluable leadership, guidance, and support through the maze of opportunities.

Optimal Cities

Project Summary

GapFinder was developed with healthy outcomes as its core principle. By harnessing the power of satellite imagery, GeoAI, authoritative data and transport modelling, we created an intuitive tool for planners and developers to simplify the decision flow for healthy planning and quantify impact.

GapFinder helps identify with simple maps where and how to decarbonise local transport by locating priority areas to expand or improve non-motorised infrastructure development, public transport, EV and green infrastructure.

Project Achievements

The project focused on progressing the Technology Readiness Level from concept to validation in three different sites in England. The main achievements were creating geointelligence models and focused user-centric interfaces to easily determine prioritisation areas for infrastructure and public health improvements. Highlights of the project include creating automated geospatial models to interpret satellite imagery for decarbonisation purposes, collaborating with local authorities and government agencies, establishing partnerships with companies with a UK and global reach in over 60 countries to support the adoption and expansion of GapFinder and defining and applying a go-to-market strategy aligned with the upcoming regulations.

Conclusions

Decarbonising transport is challenging, but it is important. Decarbonising must consider multiple aspects: socio-economic, environmental, technical, public health and planning context. The project produced three pilots in rural and urban setting, proving the concept that GapFinder can be used in multiple settings and for a variety of users and use cases. Key learnings achieved during the project were that: (1) making insights quantifiable is key, and (2) continuous engagement to make the tool intuitive for all relevant users is at least as important as developing the tech behind it and generating actionable insights.

Next Steps and Future Measures of Success

The next steps are: (1) expanding with more pilots throughout UK and (2) securing funding and contracts with early adopters from the private and public sector. We already signed MoUs with major companies from AEC and sustainability sector to get GapFinder to the market and expand the range of calibrations relevant to the technical evidence base and monitoring required in urban and transport planning. We already have interested commercial customers, working on calibrating GapFinder for their specific geographies and use cases. We are aiming for six to seven-figure further funding to increase the TRL, secure IP and new tech and sales hires as well as match funding for innovation projects supported by InnovateUK and the ESA. The TRIG programme has been essential in developing our technology and creating a strong business case for a self-service SaaS platform that once adopted can free up to 80% of the time spend by planners on analysis and contribute to reducing socio-economic costs caused by the transport system, currently estimated at £49,9Bn/yr in UK alone.

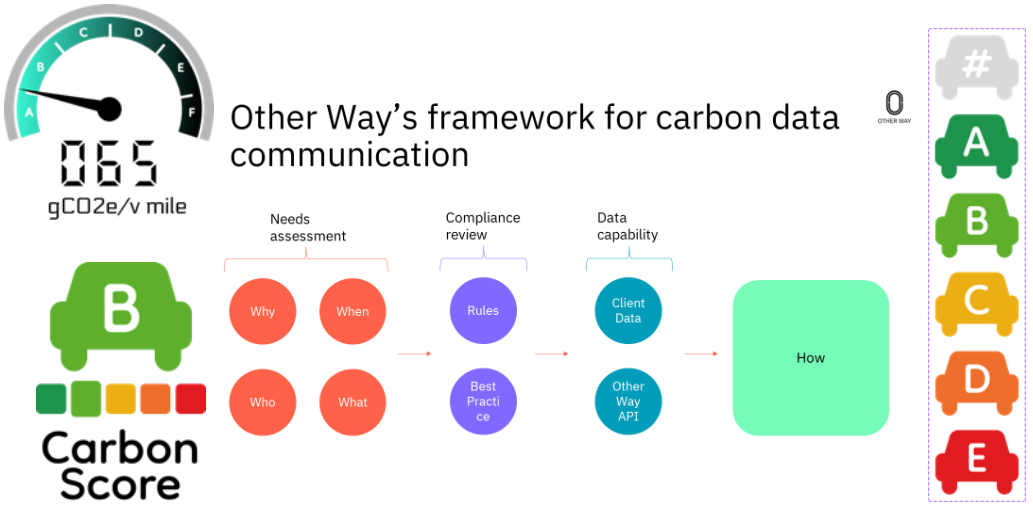
Other Way – Project Abacus

Project Summary

- Project Abacus set out to tackle this question:

"How can mobility businesses use accurate and engaging carbon data to drive adoption of decarbonised transport solutions?"

- Other Way's software offers mobility businesses accurate carbon footprint data and shows them how to embed this into their products and services. Project Abacus built and tested a framework for converting carbon footprint calculation into an actionable report and labels for clients.
- In doing so, Other Way has learned about the state of carbon footprint data use today and the opportunities for mobility businesses to build climate action into their proposition.



Project Achievements

Project Abacus achieved three specific outcomes:

1. Enhance the UK's knowledge of how accurate and engaging carbon data can be used by mobility businesses to decarbonise transport faster. Working with Fareham College and the University of Edinburgh, **Other Way has created a white paper** informing the sector on how to use carbon data in 2023.
2. Deliver a Proof of concept to two clients. **Carbon data sprints were successfully delivered for two highly innovative businesses** – Onto (electric car subscription) and OurBike (cargo bike rental fleets).
3. Prepare Other Way for commercial scale of the solution. Other Way now has **a transport carbon data framework** formed and tested with real clients.

Conclusions

Businesses want to communicate sustainability but do not have the means of doing so effectively. Challenges are numerous but this project has identified ways to overcome them.

Our survey of 100 different customer propositions across Europe found that 47% describe their vehicle or journey as "sustainable" on the home page. Yet, only 16% offer the carbon footprint of that product or service.

It's not all about labelling - behaviours are not driven by data alone but considered displaying of data supports positive decision making.

The "green glow" effect appears to be one key approach that plays on post-decision satisfaction.

Next Steps and Future Measures of Success

The greatest success for Other Way has been the opportunity to learn closely with real businesses. This has helped identify next steps in turning the data framework into a minimum viable product. There are two immediate next steps the founder will be taking forward, the combination of these steps brings Other Way faster to commercial viability.

1. Marketing: to disseminate the white paper. Other Way is attending and speaking at five conferences over the coming three to six months and intends to have a reach of 10,000 individuals. This both educates the UK sector as well as drive interest in Other Way's product.

2. Product-Market-Fit: to test the data framework with the live API and to extend the carbon data sprint to 5-10 businesses and organisations by Q1 2024.

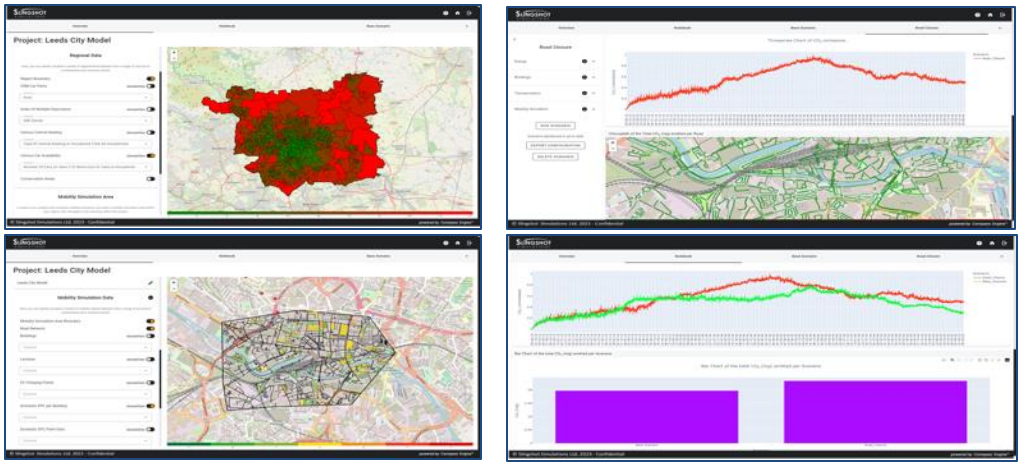
Slingshot Simulations

Project Summary

The RAPIDD (Rapid Assessment of Plans for Investment Decisions in Decarbonisation) Digital Twin project successfully demonstrated that an easy to use, intuitive digital solution can be used to support local transport decarbonisation initiatives and to rapidly optioneer:

- Aggregate relative regional carbon impact of transport decarbonisation policy options
- Street level emissions
- Correlation of changes in street level emissions with local building EPC ratings, sensitive locations (hospitals, schools) and indices of deprivation to better judge the justness of the intervention

It was demonstrated how key barriers to digital twin adoption (data deluge, siloed analytics, lack of skills) can be overcome.



Project Achievements

The RAPIDD digital twin project enabled the solution to progress from concept to a commercially available capability embedded in Slingshot Simulations Compass: Engine™ place-based decision intelligence product. By collaborating with Goleyo (transport modelling experts) and Leeds City Council (proxy customer) the solution captures best practices and addresses an end customer defined problem with scalable applicability locally, regionally and nationally.

Of significant note is that the developed capabilities contributed to the inclusion of the Compass: Engine™ product in the West Yorkshire Combined Authority's (WYCA) successful bid for £200k funding from Defra's 2023 Air Quality Grant scheme for local air quality monitoring . This, combined with an increasing pipeline of commercial opportunities for an SME in the north of England are contributing to the growth and levelling up of the economy.

Conclusions

The RAPIDD Digital Twin project successfully demonstrated the ability of a digital, place-based decision intelligence solution to support the faster, lower cost implementation of local transport decarbonisation policies and do so in a holistic, more equitable way in context of socio-economics and other critical initiatives such as local energy transition and housing and building regeneration.

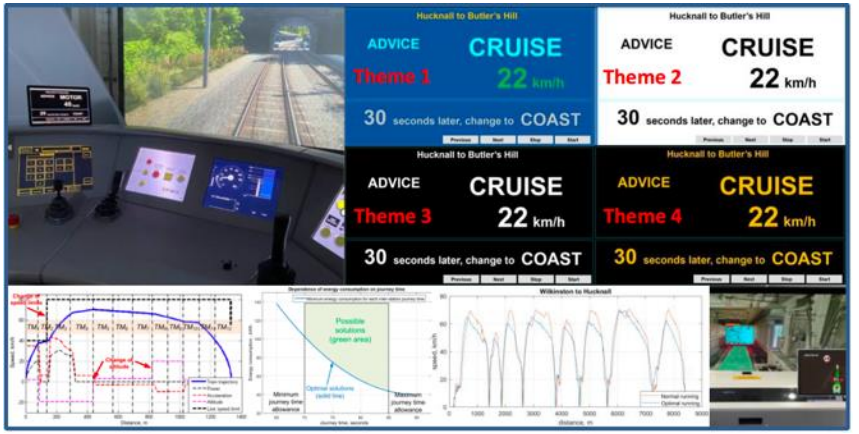
The project also highlighted the opportunity for the UK to take a global leadership position in the development and application of digital place-based decision intelligence solutions and has directly contributed to the commercial business growth and pipeline development for a high-tech software company based in the north of England.

Challenges to the accelerated adoption of innovative digital solutions in a public sector context remain and the ongoing support of the Connected Places Catapult, DfT and others is critical if we are to deliver the pace of change climate change demands.

Next Steps and Future Measures of Success

Continued development of the released capability is planned and this includes API based integration to "real time" air quality sensor data (required by the Defra Air Quality Grant Scheme funded project with WYCA) and with "real time" traffic sensor data. Future measures of success include commercial business pipeline development and commercial adoption of the solution, along with end user driven use cases to shape and prioritise the development roadmap and release plan. The TRIG22 project has enabled the acceleration of the capability from concept to commercial product. Post project completion steps include the development of sales and marketing collateral and a marketing campaign based on these materials. Slingshot Simulations would like to place on record our sincere gratitude to the TRIG22 stakeholders and cohort members for this opportunity.

University of Birmingham



Project Summary

Automation systems were introduced as appropriate approaches to reduce carbon emissions for train operations. However, the UK rail has a long way to build full automation. DAS is perceived on the transition pathway for train automation. A significant energy reduction has been demonstrated and achieved from previous work completed by the project team using a prototype system. However, drivers from different backgrounds perform differently on the use of DAS. The aim of this project is to identify the drivers' requirements on the use of DAS, propose and verify a solution to improve the system performance and reduce train energy consumption.

Project Achievements

This project includes the development of a DAS solution aimed at reducing traction energy consumption. The solution considers driver requirements and seeks to maximise acceptance while improving user trust. To achieve this goal, the project team consulted with various individuals in the rail industry regarding DAS use and development. Based on the feedback received, the team developed a DAS system based on a prototype DAS system previously developed and validated through field trials in both the UK and worldwide.

The new system underwent verification and further adjustments in a laboratory environment at University of Birmingham. Furthermore, a trial test of the DAS was conducted on a real tram line to further assess system performance. The test results demonstrate that by using the developed DAS, train energy consumption can be significantly reduced by up to 11% without affecting journey time constraints.

Conclusions

The outcomes of this project have the potential to significantly reduce the energy usage for railway transportation. The developed DAS has demonstrated its potential benefits through field tests showing a up to 11% reduction in energy consumption. Based on the saving, approx. £70,000 of the annual traction bill can be reduced on a single rail line. Considering the number of railway network in the UK and worldwide, the potential saving would be even larger. Furthermore, the new DAS solution aims to enhance the knowledge and improve the skills for human drivers, rather than use automation machines (e.g., ATO) to replace them.

Next Steps and Future Measures of Success

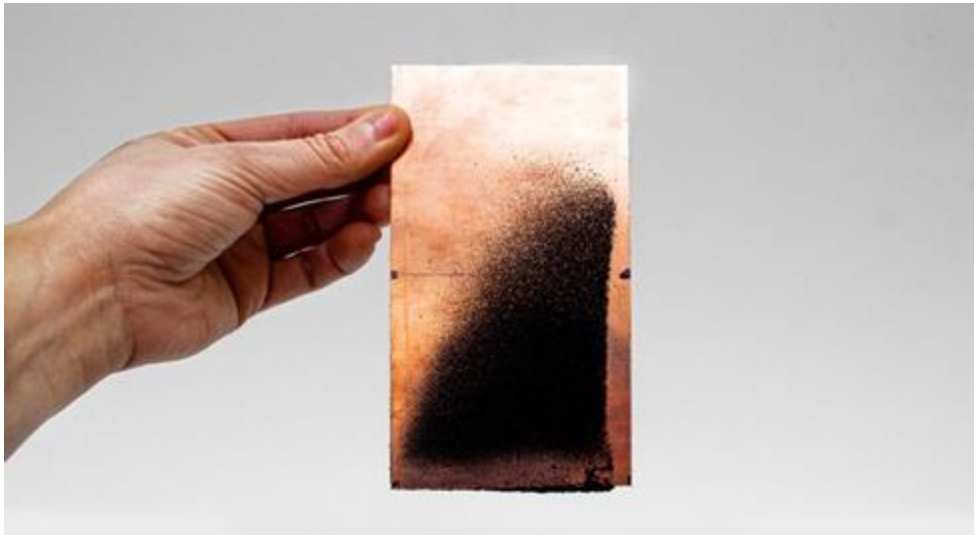
The developed DAS solution is cost-effective and highly efficient, making it suitable for widespread adoption on various urban rail lines with line-of-sight driving. The project team at the Birmingham Centre for Railway Research and Education (BCRRE) is planning to collaborate with railway consulting companies to provide additional support for Nottingham Tram, Manchester Tram, West Midlands Metro, and other rail networks, including training courses, field tests, and implementation. The project team has also established contact with experts from Network Rail, Resonate, Hitachi, and other railway companies to further investigate the application of DAS on the UK mainline. Regular meetings have been arranged to exchange knowledge on DAS and advance the technology for the benefit of the UK railway.

Furthermore, the project team is planning to integrate new image processing and object detection functions into the DAS. These new functions will utilise cameras, lidar, and radar sensors along with AI algorithms to automatically detect trackside signals, potential obstacles, and nearby pedestrians and vehicles. This will provide early warnings to the drivers, enhancing train safety and improving operational performance.

The Tyre Collective

Project Summary

Particulate matter (PM) from Non-Exhaust Emissions (NEEs, tyre, brake and road wear) impacts our environment, waterways, air quality and health. DEFRA estimates that 60% of PM2.5 road emission comes from NEEs. This is projected to reach 90% by 2030, with EVs producing more tyre wear. Without capturing this stealth pollutant, transport will never reach zero emissions. The Tyre Collective is spearheading the capture and monitoring of tyre wear, accelerating the shift towards zero-emissions.



Project Achievements

Our project focused on developing a new prototype to capture NEEs and testing it in the field. The main achievement was building a physical prototype, testing it in the field, and analysing the samples within the timeframe. We collaborated with the Transport Research Laboratory (TRL) and Smart Mobility Living Lab (SMLL) on the trial and worked with Particle Vision on sample analysis. We presented our technology in multiple exhibitions and identified potential customers to pilot the new device.

Conclusions

The outputs of the project were to evaluate the feasibility of retrofitting our technology into a new form, design, build and test the first prototype in a relevant environment. It helped accelerate the idea from TRL 2 to 4. We successfully developed the prototype and tested it in the field. We experimented with different materials and geometry optimisation to improve capture efficiency and reduce cost. We also installed a passive sampler to understand NEE composition.

Next Steps and Future Measures of Success

The next step is to run more trials in different environments and iterate and design a more robust, compact device. We have s poken with and received interest from commercial customers and local councils to pilot our device. We applied for additional IUK funding to understand customer needs and continue developing the device. This project is outside our regular R&D activities. The TRIG programme helped us explore this untapped opportunity and derisk this project, enabling us to reach TRL 4. Our conversations with Connected Places Catapult and the Department of Transport have also been valuable.

Taisan

Project Summary

Today's electric vehicles (EVs) have inefficient battery packs due to heavy passive parts like aluminium housing, module components, and fixings. Therefore, gravimetric, and volumetric energy densities decrease significantly and fail to make efficient EVs. The cost and assembly complexity also increase. However, the main challenge is they use lithium-ion cells which are unsustainable, toxic, flammable, high impact on environment due to non-clean extraction techniques of cobalt, lithium, nickel and copper. They also use child labour and pay small amount to do dangerous job.

The project aimed to demonstrate highly safe, affordable, and sustainable method of storing energy in modern mobility solutions. Our team built and tested proprietary sodium-ion battery pack, removing toxic, limited metals. Our battery innovations cover cell system integration, control, and safety. We simplify by removing module-level parts, use lightweight fire-retardant battery housing, eliminate fire risk and lower cost of battery pack.

Project Achievements

Our project focused on building 10kWh sodium-ion battery pack for micro electric cars. The pack is designed based on our customer requirements.

- Accurate simulation models are generated and metrics validated at lab-level;
- Our sodium-ion cells are successfully tested at HPPC tests and applied to real-world conditions (i.e. WLTP drive cycle). It's confirmed that our cells also add system structural strength by 30% and reduce the overall cost by 25%;
- As we showed our progress to customers, we signed 6 more MoUs with automakers, totalling to 19. We received international orders from USA, EU, Saudi Arabia and India;
- It's World's 1st Sodium-Ion battery pack using "cell-to-pack" and fire-retardant concept

Conclusions

1. We are convinced that future battery systems must be sustainable and low cost in EVs;
2. Our project confirmed that sodium-ion cells can perfectly work as safe, efficient and affordable energy storage solution using our proprietary technology;
3. "Cell-to-Pack" concept provides mechanical and electrical benefits on pack-level system;
4. Our team managed the project efficiently without any delays. Planning was important;
5. Customers were keen to see hardware in-person which helped us to sign MoUs;
6. The simulation modelling predicted performance and allowed us to optimise further;
7. We learnt to always have Plan B when choosing suppliers;
8. Early plan and strategy are always good to have clarity on the actions;
9. Risk assessment helped us to work out solutions accordingly;

Next Steps and Future Measures of Success

1. TRIG allowed us to move further on technical milestones of Sample B/C/D using our partner's facilities to certify our product;
- Tests are the following = Environmental: water sealing, vibrations, thermal & Electrical: drive cycles & Mechanical: impact, strength;
2. The main goal is to commercialise our battery pack design and supply to automakers;
3. We aim to convert our non-binding Memorandums into binding contracts to supply battery packs to OEMs;
4. To do this, we aim to fundraise and expand our team and operations within the UK;
5. Our team plans to develop 2 more battery packs at different sizes: 20kWh and 50kWh, based on the requirements from our customers;

University of Hertfordshire

Project Summary

Our project focused on the University of Hertfordshire as a major travel generator outside a city. It looked at options for reducing car travel and carbon emissions from travel to and within the University and the surrounding area. There is very limited information on transport options for areas outside cities and we wanted to use the University to create a template for other major travel generators in similar places, in particular to explore if it could integrate various transport offers and become a mobility hub and whether such options would be attractive to likely users.

Project Achievements

Our project investigated existing travel options and found that the University is already providing a number of mobility services. It runs its own bus company, Uno, providing bus services across West Hertfordshire (Uno have been a partner in this project); it charges for and limits onsite car parking and runs a park and ride service; it also offers or has offered other mobility services including a basic bike hire service and previously an e-car club. This project ran a programme of structured interviews with mobility providers, including Enterprise, Mobilityways, Zeelo and Transport Initiatives (bike hire specialists), with key people in the University and in surrounding areas. It also interviewed staff and students on their attitudes to travel and what their responses might be to new mobility services.

Key highlights were: Identifying a range of opportunities for new mobility services in addition to existing provision, also good practice elsewhere that could be adopted by the University and by similar travel generators outside cities. We also found real enthusiasm for new mobility options from those we interviewed and gained valuable insights on barriers and possible solutions to individual mobility options and to a mobility hub as a whole.

Conclusions

The project has shown that it is possible to provide good zero carbon mobility options in places outside cities and that these can apply in a range of places and circumstances. It also identified ways to overcome barriers to these options plus potential roles for the private sector, travel generators, landowners and local authorities in implementing these options, supporting electric vehicles and charging for them and also providing alternatives to single-occupancy car use.
The project made or revived useful links between the university and other organisations which will benefit ongoing dialogue between university students, staff and the wider Hatfield community.

Next Steps and Future Measures of Success

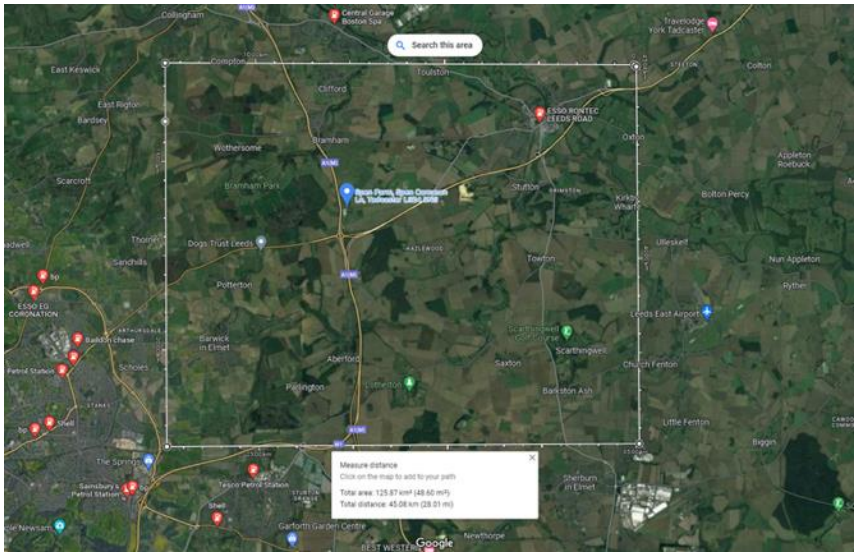
This project has led to fruitful discussions both within the university and between the university and outside bodies. There is significant interest in taking forward many of these discussions and to arrange meetings between the private sector companies we interviewed and key people at the University and surrounding area. We envisage existing initiatives and proposals – for example Vehicle to Grid charging and public EV charging at the University – can be developed as part of these discussions. In addition, the project has helped create a vision of "The Connected Campus", to which Uno can contribute moves to electrify its bus fleet, develop new partnerships and promote integration of buses with other transport and mobility offers. The TRIG project findings are a valuable contribution as an important part of the Smart Mobility Unit's wider programme of work on developing options for low carbon transport outside cities. It will feature in work with the sub-national transport bodies, especially England's Economic Heartland and Transport East (TE) – indeed we will be running a Roundtable with TE on mobility hubs to build on the TRIG research. In this it will contribute to the Government objectives of supporting low-carbon economic growth and Just Transitions.

University of Leeds

A MOBILE ENERGY BUFFER UNIT to support rural transport decarbonisation

Project Summary

This project assessed the economic viability of a Mobile Energy Buffer Unit (MEBU) technology for mobile charging of electric vehicles (EVs) in rural areas of the UK.



Project site 1: Study area around National Pig Centre @ University of Leeds

Project Achievements

The architecture for our MEBU based on the energy consumption of EVs has been designed using data from our two rural study sites.

A 'plug and play' of battery systems can now be achieved and, based on the energy demand of electric vehicles (EVs), the total capacity of a battery energy storage system can be determined.

Taking the two study sites as examples, our studies showed that there is no need to build a fixed charging station for MEBU.

Conclusions

The cost analysis showed that the utilisation of MEBU can significantly decrease the expenses associated with meeting the EV electricity demand of rural users.

The construction of an EV charging network combining MEBU with stationary charging stations can economically meet the EV charging needs of rural areas.

Based on this research, MEBU can also fully meet the charging needs of EVs in various cities and towns on the premise of reducing costs and hence have a huge market potential.

Next Steps and Future Measures of Success

Findings of our feasibility study informed end-user needs, economic benefits and market demand hence providing valuable data to develop a route to market strategy for MEBU. We will work with the NEXUS innovation centre at the University of Leeds to conduct a range of engagement and commercialisation activities, and develop suitable business models to achieve the greatest impact and adoption of the technology.

White Motorcycle Concepts

WMC300LM

Aerodynamic First/Last Mile Hybrid Delivery Motorcycle

Project Summary

Work completed creating our police motorcycle (WMC300FR), defining the interactions with other systems within the motorcycle & producing a 25% aerodynamic gain against the standard motorcycle, along with a detachable battery hybrid, producing a 44% CO_2 reduction forms the basis for the expansion into another sector on the same platform. Starting at TRL 2 & MRL 2 (Mar 23), by the end of the project we aimed for this to be TRL 4 & MRL 4 to enable commercialisation in 2024, addressing local decarbonisation and covering three DfT priorities:

Tackling Climate Change – is at the core of the project, our initial application vehicle has reduced the CO_2 emissions by 44% across the standard drive cycle. A full electric version will follow by 2026.

Increase our Global Impact – the solution proposed is relevant around the world, practically reducing CO_2.

Building Confidence – increasing the number of motorcycles reduces congestion.

Project Achievements

- Re-packaging of WMC300FR to open up space at the rear to accept cargo
- Re-engineered the fuel system and electrical system for new configuration
- Create a prototype four battery electric drive system
- Integrate all changes into a fully operational prototype motorcycle
- Greater understating of electric only running requirements
- Creation of bespoke internal electric drive testing equipment that can be used on all future projects
- Advanced our customer engagement through the development of the prototype

Conclusions

- The final motorcycle can be produced technically and commercially
- The project is now at TRL 5 and MRL 4 It is not possible to complete re;gen through the current configuration
- The amount of work required to produce electric only running is possible and understood, but will be developed as part of the production prototype
- We have a clear plan to take this motorcycle from prototype to production
- Further market engagement confirms the requirement for our proposed product
- It is possible to create a motorcycle that will safely and functionally carry the loads required by our target customer base

Next Steps and Future Measures of Success

WMC will look to commercialise the WMC300LM by:

1. Develop the demonstration prototype into a production prototype (by May 2024)
2. Deliver a pilot fleet to understand the capabilities and limitations of the WMC300LM operationally (May-Oct 2024) and sell into target customer base (Oct 2024 onwards)
3. Target OEMs with the patented technology to achieve environmental impact at scale

Funded by
UK Government

Improving the Rail Passenger Experience

Delivered by

CATAPULT
Connected Places

Distributed Analytics Solutions Ltd

Project Summary

The most overcrowded UK train services operate at 187% capacity. This is acutely felt by disabled passengers; 61% report limited space as a primary concern. Overcrowding directly affects customer satisfaction, industry confidence, and network profitability.

Distributed Analytics will address congestion with an AI solution called 'Find My Way'. Find My Way empowers passengers to plan and adapt journeys based on live Computer Vision Deep Learning data. This tool maps congestion at carriage scale, serving metrics to a mobile application. Well informed passengers can elevate their own user experience; reducing overcrowding and increasing satisfaction to rebuild confidence in the rail network.

Project Achievements

Distributed Analytics have delivered the first ever combined Object Detection and Human Recognition AI algorithm suitable for use at scale in rail passenger experience management. This lightweight solution is robust and reliable, with a performance accuracy of over 90%.

A bespoke dataset was collated and labelled to train this Machine Vision AI, offering another first of its kind resource for AI innovators in the rail and transport space. This asset accelerates the development process for future passenger-level rail Computer Vision technologies – helping Distributed Analytics and other businesses to apply brand new AI techniques without significant spin up time.

Conclusions

Find My Way has fuelled two first of their kind innovations in the rail passenger experience AI space: a combined Object Detection and Human Recognition algorithm suitable for use at scale, and a bespoke labelled passenger and seating imagery dataset to accelerate future Machine Vision innovation.

This has demonstrated the validity and value of applying Image Recognition AI to the rail congestion challenge, the necessary first step in an industry wide AI revolution process.

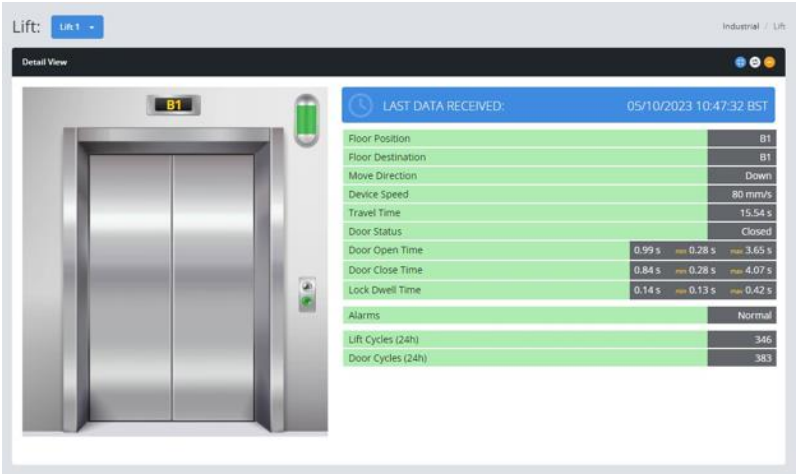
Combined with intensive research into cutting edge AI practices, this work creates a knowledge and toolset resource able to support future innovation – illuminating the way forward for enhancing user experience across UK passenger rail.

Next Steps and Future Measures of Success

The next steps are live environment testing and dataset enhancement with real UK rail CCTV footage. Subsequent development of the mobile application frontend will then take Find My Way beyond TRL 4 into a fully commercial product.

DA have greatly benefitted from the networking and business guidance opportunities stemming from TRIG, helping the team to forge new connections and elevate business planning and strategy. Beyond providing the power to help innovative new products and technologies commercialize, TRIG brings significant value to any organization working to grow or connect with their peers across both the transport industry and academia.

DBR & Associates Limited



Project summary

For passengers with restricted mobility lifts are essential to access railway station platforms. This project will focus on lift services, giving disabled passengers the confidence to use the rail network.

This project provides the opportunity to demonstrate how a different monitoring approach can be more effective, less disruptive and provide a quicker route to maintain asset availability. Our innovation moves from individual asset data collection mechanisms to a unified monitoring system capable of detecting minor changes. Then analysing running signature plus real time visualisation whilst performing maintenance activities onsite, delivers innovation for a proactive maintenance methodology.

Project Achievements

The key innovation within this project is the development of hardware which can read existing internal signals from asset controllers and when coupled with algorithms capable of detecting minor changes in signal structure as the asset moves through its normal activity sequence enabling proactive maintenance strategies to be developed. The aim is to identify/predict the potential cause of failure before the asset stops and develop a maintenance strategy to improve reliability & optimise maintenance cost.

We have been able throughout this project to validate the concept of simple lift data collection techniques, together with a user interface that shows lift real time and historic data, with the ability to detect minor changes in running signature and raise alerts requesting containment/corrective action prior to actual lift failure in service.

Conclusions

We have achieved the outcomes and outputs we expected. Now, being able to read outputs directly from lift controllers, our research and development will continue to develop monitoring technologies that are bespoke to clients requirements, giving access to their data, displayed and analysed to suit their business needs.

The support we have received from the TRIG team has been enormously beneficial not just in delivering the project, but in helping us develop our business. There has been a genuine interest in us being successful, challenging what we do and how we do it.

Next steps and measures of success

A key priority is to move forward is to achieve TRL 9, by disseminating our outputs through the Connected Places Catapult and Department for Transport, both have a position in the rail sector and experience in integrating new technologies into complex rail facilities. The Department for Transport have a key business objective in putting the passenger first, provides us with a platform for a route to market by being able to demonstrate we have a remote monitoring system ready for commercial deployment. To achieve TRL 9, further testing will be required across a number of lifts to reflect different OEM's age and type. This will be supported by outputs that include demonstrator sites, comparative studies showing business benefits and expected ROI, technical reports, specifications and installation manuals.

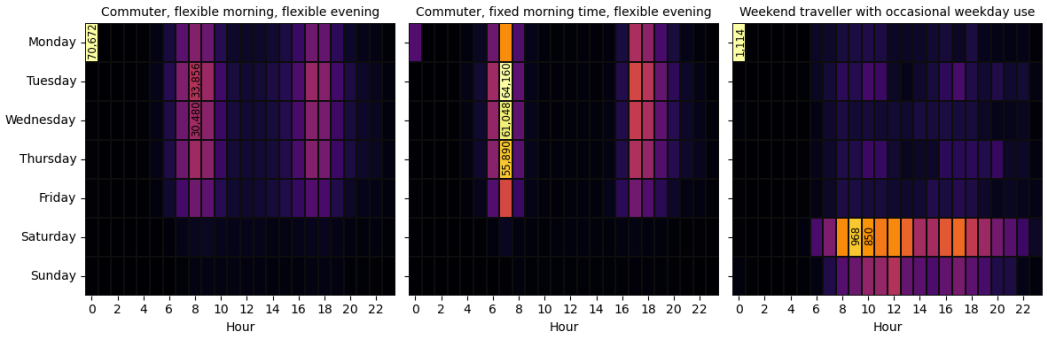
By providing a common communication protocol we intend to extend our monitoring application across all assets across the transport infrastructure have asset controllers including lifts, escalators, ventilation/HVAC system identical to those we are monitoring now. Up until our TRIG project all R&D has been self funded. To enable us to achieve significant growth and develop a route to market, we need to seek additional funding.

Esoterix Systems

Project summary

This project, Personalisation in Rail, aimed to categorise rail travel behaviour profiles. Train Operating Companies (TOCs) will be able to use these travel profile types to enhance and enrich their assignation of individual passengers to their pre-determined passenger personas. Consequently, their service information and marketing communications will become more relevant. Messages that resonate with the Passenger increase loyalty alongside travel and will, ultimately, generate more revenue for the railways.

The project addresses the DfT's strategic priority of 'Improving Transport for the User,' whilst also addressing the need to attract and retain passenger custom following COVID.



Heatmaps of travel frequency by day of the week and time of day for 3 passenger groups

Project Achievements

Esoterix analysed the travel behaviour 35,000 rail passengers (as identified by their ITSO smartcard number) from January 2022 to July 2023 inclusive. Machine learning techniques identified 34 usefully distinct profile types, varying significantly from regular commuters through to weekend leisure travellers (see figure).

The correlation of travel profile type to home station location was assessed, challenging the assumption that passengers from the same neighbourhood have similar personas.

Furthermore, the project demonstrated how special interests could be ascertained from the travel profile, potentially enriching the TOC's assignation of its generic persona. Passengers with different travel during school holidays were identified (parents, students and educators) as well as those using rail for specific leisure or entertainment purposes, for example West Ham and Chelsea fans.

Conclusions

The project produced technology which can demonstrably;

- correct the passenger persona assigned to a Rail Passenger based on their travel profile; and
- enrich the assigned passenger persona through the identification of special interests.

Furthermore, the technology can provide a travel-based passenger persona segmentation where it is infeasible to source one through customer surveys.

It will mean TOCs can be more relevant in their communications with the Rail Passenger. For example, promoting weekend travel to those who rarely take the train on Saturdays and Sundays, and promoting family days out to parents.

Next Steps and Future Measures of Success

Personalisation in Rail has shown that TOCs already have access to a rich seam of data they can use to send more personally relevant emails. Esoterix intends to:

- collaborate with one or more TOCs towards the trial of the technology in a live environment;
- integrate event data feeds, to provide the TOC with further promotional opportunities; and
- work with industry to standardise the identification of travel profile types, thereby facilitating the profiling of multi-modal journeys in the future.

GoMedia

Project Summary

Luna is a personalised digital sign language avatar. The aim of the project was to investigate current technology around AI powered real-time sign language translation tools and how this could be adapted to benefit public transport users. The project explored using digital avatars to provide real-time journey information, onboard announcements and on station announcements in sign language to the user's personal mobile device.

Project Achievements

A technical understanding and technical foundations have been laid to provide a system that users can view on their own device to access journey information in either text or sign language. A prototype and different designs were created to validate this from a user's perspective as well.

The project resulted in a close relationship between Signapse and GoMedia, two companies that hadn't worked together before. A promotional video has been produced to share the vision around the use of sign language in public transport.

Conclusions

Providing a digital service to passenger's own devices to access journey information, on board announcements and station announcements and have this available in sign language as well is achievable.

Limitations around current video rendering can be overcome with clever user interface design and architectural design to provide a good user experience.

A live proof of concept is now required to test and enhance the solution to develop a commercial product.

Next Steps and Future Measures of Success

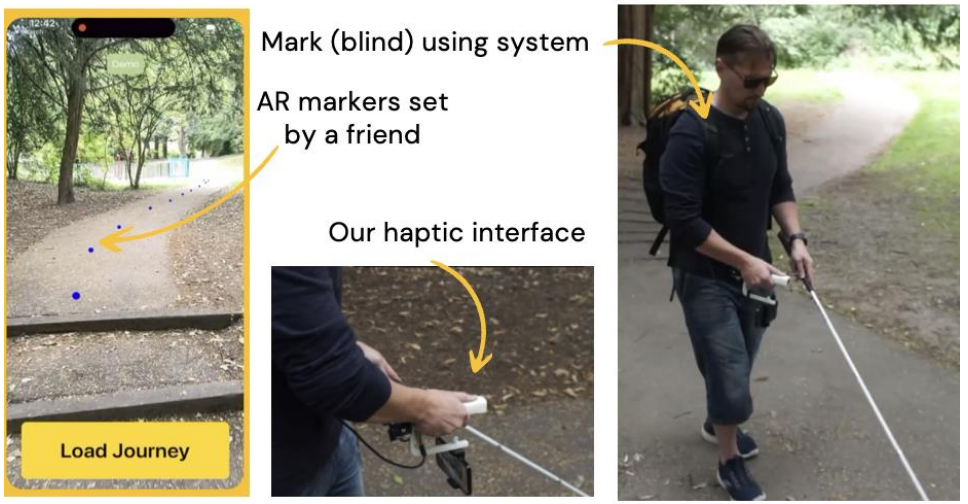
A new funding project is needed to implement a proof of concept in a live environment and test the solution with sign language users. Initial discussions have been made with train operators to explore opportunities for potential funding. Once a proof of concept has been completed the project is ready for commercialisation and can be expanded to support other sign languages (e.g. American Sign Language) and open up export opportunities.

MakeSense Technology

Project Summary

Via TRIG MakeSense proposed the development of a railway navigation smartphone application for vision impaired users. We set out to leverage the emerging Augmented Reality technology to set a series of virtual waypoints in space. Sighted friends/carers/staff could *Place* out a bespoke walking routes though a stations, which could then be *Traced* autonomously by any VI person, at any time.

MakeSense succeeded in developing a Place and Trace AR iPhone application which was used by VI persons to make various journeys and is continuing development with private investment capital.



Project Achievements

- Development of an effective navigation technology which leverages Augmented Reality in a totally new way.
- Filing of a UK patent with novelty found during the patent search.
- A journey from Bermondsey to Canary Wharf on the Jubilee line was demonstrated using a derivative our Place and Trace technology.
- We secured £100k of investor capital to further investigate the project outcomes.
- We tested our tech in live environments with vision impaired persons.

Conclusions

While the concept showed promise and certain practical advantages, it wasn't without challenges. Issues, such as the necessity for precision in initial setup and limitations in indoor navigation are surmountable but require further refinement prior to deployment. Nonetheless, the project demonstrated that with innovation and user-centric design, AR can be harnessed for real-world, impactful solutions that cater to vision impaired persons.

Next Steps and Future Measures of Success

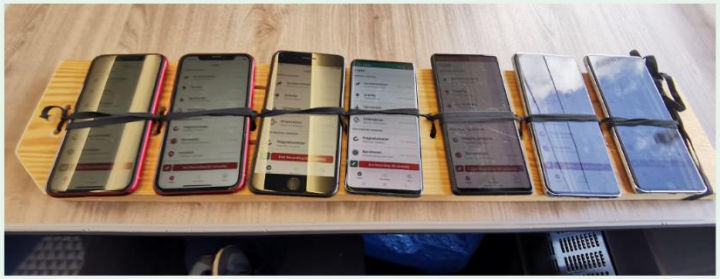
MakeSense is actively addressing challenges discovered during its research phase. Key concerns are stabilizing AR anchors and improving indoor navigation. A solution found involves using Google's GeoSpatial API, which offers expansive AR capabilities. Despite AR's current constraints, the technology is rapidly advancing. Moreover, a feature enabling live teleassistance from sighted individuals may help in situations where AR anchors destabilize or if a traced route is unavailable.

After securing £100k in pre-seed equity financing in May 2023, MakeSense aims to raise £2.5 million in the next half-year. Their goal is to launch the Magic Torch product by 2025. While the AR Place and Trace project remains one of our initiatives, we are exploring other promising approaches.

PolyChord

Project Summary

Problems occurring in the tracks cause jolts and vibrations that are not only uncomfortable for passengers but can be unsafe. Furthermore, maintenance causes costly and inconvenient delays and speed restrictions. PolyChord believes the answer to this problem is in the hands of the customer and is developing the RoRi Rough-Ride Detection tool that uses data from customer mobile phones to detect issues with the track and vehicles. In this project, PolyChord Ltd worked with Focus Sensors to investigate whether Fibre-Optic Movement Sensors (FOMS) can be used to improve the locational accuracy from ~5m with GPS to ~1m.



Project Achievements

The project focussed on collecting mobile phone and FOMS data from the same route and time. With data, we could then proceed with a feasibility study to establish how we could use FOMS data to get a better fix on the location of issues detected by mobile phones with PolyChord's RoRi tool.

We successfully collected the necessary data and ran the RoRi pipeline on the phone data which allowed us to establish methods that connect a RoRi outlier detection with the position of the train, and therefore identify the exact location of the issue by focussing analysis on the location and time of the train. We also established methods to synchronise the data even when the timestamps are not synchronised.

The most important outcome of the project in many ways is the learning that we need to design our mobile-phone data collection app so that it records the GPS satellite time rather than the phones local time, to enable easy synchronisation of datasets. The other important outcome was the drastic boost to PolyChord's relationship with LNER and Network Rail, resulting in a grant application and now discussion about East Coast partnership funding.

Conclusions

We have concluded that outliers from RoRi can be associated with train position using timestamps, and then the location of a fault more accurately pinpointed by extracting the section of FOMS data associated with a particular train position and performing outlier and/or correlation analysis on this data. This will inform the future development of RoRi and will ensure that we record the satellite time rather than phone time in recording the phone sensor data. We have also developed a framework for dealing with instances where the FOMS unsynchronise with the satellite for any reason. The project is considered successful.

Next Steps and Future Measures of Success

We are in discussions with the East Coast Partnership to fund the next phase of development of RoRi, which is to develop a tool that uses customer mobile-phone data and develop the API needed to collect this data via the LNER phone app. In the meantime, we will apply for the next Smart Grant and any other funding we identify that is suitable. We will also look to other countries with rapidly expanding railway networks, who may have more money and can be quicker moving, such as the UAE, to develop the system. TRIG has provided us with invaluable learning that will inform future development of the RoRi tool and has drastically improved our relations with LNER, Network Rail, and our TRIG collaborators Focus Sensors.