OUR YEAR IN NUMBERS

HydroFLEX in service passenger train

57 live research projects

our LinkedIn page gained 780+ followers

97 registered PhD students

4 new programmes

WON GREEN IMPACT GOLD AWARD

2 new apprenticeships
2 new Foundation Degrees

DELIVERED BY
ADVANCED TRANSPORT & INFRASTRUCTURE NATIONAL COLLEGE
OUR YEAR IN NUMBERS

NEW RaiseE Business Centre in Goole officially opened

On average 250 monthly views on our BCRRE Blog

BCRRE in the News... featured on The Times, BBC, Sky News

Our railway research supported with the Birmingham 2022 Commonwealth Games

60 events

x2 ministerial visits

95 current level 7 degree apprentices

Our Twitter following has increased to 2500

Signed 5+ new framework agreements
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Welcome to the BCRRE Annual Report for 2021-22. It is a great relief to have normality resume and students and staff back on campus. I know that I, along with many of my team really, thrive on the contact with others to spark ideas and fascinating conversations.

For us the return to some normality has been particularly important as in the last 12 months we have welcomed a huge number of industry partners and students into our fantastic new building on campus. In June we were delighted to be able to co-host the World Congress on Railway Research here in Birmingham, bringing together many of the international railway research and innovation community to Birmingham – a truly wonderful experience and absolutely superb to catch up with so many friends and acquaintances as well as meeting many new people. As I write this, we are still coming down from the huge high in Birmingham of hosting the Commonwealth Games 2022. Both hockey and squash competitions were held here on campus, and I know that most of us took advantage of being able to watch all this top-class live sport right here on our doorsteps.

We made significant strides in our research and education activities that you will read more about in this report. A number of new academic staff have joined the School of Engineering and bring interest and relevant capability to our rail group, while I am thrilled to report that several of our academics have obtained promotions. The absorption of the National College for Advanced Transportation and Infrastructure into the University of Birmingham group has given us the opportunity to offer complete educational pathways for learners to obtain academic and vocational qualifications.

Our work with industry has continued to develop rapidly with significant partnerships growing with Siemens Mobility at Goole and with the Welsh Government and the Global Centre for Rail Excellence in South Wales. The launch of the BCRRE Rail Innovation Cluster has allowed us to focus on our core interests and activities – supporting SMEs and enabling innovation and internationalisation – and relinquish the former Rail Alliance activities.

Finally, a final mention to our hydrogen train project that wrapped up last November at the United Nations COP26 climate change conference in Glasgow. This 3-year project showcased us perfectly demonstrating our ability to take fundamental research, to develop and test it, and prove it in demonstration and operation ready for commercialisation. Our contribution to the University’s success in the 2021 Research Excellence Framework comes from our practical focus and desire to see our research make a real-world impact. Long may this continue!
We continue to drive the research agenda for railways forwards starting with the highlight for research this year, our hosting of the World Congress in Rail Research (WCRR 2022). This was jointly hosted with our partner RSSB and took place in Birmingham at the ICC. This centre stage provided us and our research peers worldwide, from both academia and industry with a platform, to showcase some of the very best of our research. It also provided an opportunity to critique and receive the real and very much now challenges from industry practitioners. It has been an excellent year in terms of dissemination in other ways too, with our HydroFLEX demonstrator vehicle taking centre stage at COP26 in November 2021.

A significant achievement (and accolade) was the recognition of the excellence of our engineering research in the UK Governments research assessment REF2021. As part of the School of Engineering, we in BCRRE are proud of the contributions which placed us among the very best engineering institutions in the UK. Our number of 4* papers – which are judged to be world-leading in terms of originality, significance and rigour – were exceptional, placing us top 10 in the UK. Not only this, but all of our research impacts also including those focussed on rail, where judged to be internationally excellent.

As you will read elsewhere in this report, we continue to make significant progress and break new ground with the research in all our strategic areas.

Our successful research teams comprise of PhD students, Research Fellows, Academics and BCRRE Professional Services staff. As one big group, they all work extremely hard to deliver research outcomes and impact which I believe is second to none in rail. Together with our industry partners, collaborators and funders, we have been busy presenting at research conferences, publishing papers, completing PhDs, delivering project outcomes and technical reports and, where confidentiality allows, using our research outcomes as key elements in our education and knowledge transfer activities.

As we begin the 2022 academic year, I have never been prouder of our research teams, nor more excited about our prospects for the coming year.

**Highlights during the year include:**

- Been ranked in the top 10 (of 157 academic institutions) in REF’21
- Seen academic research leads promoted to Professor
- Worked closely with our Industrial and Academic partners in UKRRIN
- Signed 5+ strategic agreements
- Worked closely with Network Rail under our framework agreement,
- Working across several projects and commencing 5 NR funded PhD projects.
- Registered 97 PhD students
- Published around 100 peer-reviewed research papers
- Presented the UK’s first Hydrogen Train at COP26
- Seen the outcomes of our Rail digital twin in support of the 2022 Commonwealth Games

Professor Roger Dixon
Professor of Control Systems Engineering
2021-2022 has been a year of change for Education within BCRRE, taking the best of what was learned from teaching during the pandemic and, when possible, welcoming our students from home and overseas back to campus. The hard work, dedication, and enthusiasm of staff and students alike have made it a particularly special year.

Our well-established, Birmingham based MSc programmes in Railway Systems Engineering and Integration and in Railway Safety and Control Systems continued, with over 50 students joining the two courses from the UK and around the globe. These students included full-time, part-time and degree apprentices. Particularly welcome were the first group of students from India’s National Rail and Transport Institute’s collaboration with BCRRE. Students will study railway engineering in India for a year before coming to Birmingham to complete their MSc.

We also welcomed our fourth intake of Degree Apprentices following the Rail and Rail Systems Principal Engineer Level 7 Degree Apprenticeship. Apprentices follow a three-year course where they study one of the MSc Rail courses alongside compiling a portfolio of their learning and experience, which is matched to the Engineering Council’s standards for chartered engineer status. Our first intake of apprentices are now completing their Technical Work Based Projects and we will be holding our first End Point Assessments in the next few months. The University of Birmingham will be the first institution to graduate Level 7 Degree Apprentices in Rail.

Teaching has continued with bi-modal delivery. Students were all given the opportunity to come to the Birmingham campus for lectures and labs, but we also understood that this might not always be possible. Therefore, we have continued to live-stream our lectures, which has been widely appreciated when students or their families tested positive for Covid and they were unable to leave their homes. Due to the success of live streaming, this is something we will continue to do in the future as part of our strategy to increase student diversity.

The opening up of borders also allowed us to run the first European Study Tour for two years. 20 students and 3 staff visited a number of companies in The Netherlands, France and Switzerland to learn, amongst other things, about railway operations in Paris, station design in Amsterdam and rolling stock construction in Zurich. The week was exhausting, but one which the students will not forget.

Graduation ceremonies returned this academic year, and it was lovely to see so many of our students back in gowns and collecting their certificates. As ever, our graduates were very much in demand by employers and all of those who were seeking employment have secured positions. The class of 2022 are now eagerly finishing dissertations and awaiting the results of many years of hard work, so there will be further celebrations to come. There will also be the first graduates of BCRRE’s innovative postgraduate certificate in Digital Railway Leadership, which prepares leaders within the rail industry for the challenges of digitalisation.

This year BCRRE began its collaboration with Primary Engineer as we are keen to support the work they are doing in promoting engineering as a career. The collaboration culminated in a day of celebration where Primary School children from age 6 to 11 came to the Engineering Building to show the rail projects they have been working on. The project reached a total of 537 pupils and their teachers, who agreed that the project had had a positive impact on pupils career aspirations in engineering and STEM subjects.

The collaboration between National College for Advanced Transport and Infrastructure (NCATI) and The University has also continued. This partnership represents a significant development in supporting skills, education, and training across the sector at all levels of further and higher education. Within BCRRE we are excited to be part of this and to working closely together to mutually enrich learning in the rail sector.

So, onto 2022-2023, no doubt it will be another exciting and challenging year, but one we are all looking forward to.
The BCRRE Enterprise and innovation team has been busier than ever fostering exciting collaborations, engaging with the global rail industry, driving innovation and commercialising our research and education capabilities and activities.

In September 2021 several of us were in sunny Serbia for the South East Europe Mobility Fair where we joined the UK Ambassador Sian MacLeod, the University of Belgrade, the Rail Cluster for South East Europe and the wider regional rail industry. The fair brought local and UK based SMEs together to discuss ways to develop the railway supply chain between the neighbouring countries and explore potential partnerships to develop the region’s rail network and supply industry.

We continued with our outings, the largest being our presence at November’s United Nations COP26 conference in Glasgow with HydroFLEX, the UK’s first mainline-approved Hydrogen train. This time making trips as a passenger service to and from Glasgow Central Station. It was a busy two weeks showcasing what clean transport can look and operate like in the very near future. We saw visits from the royal family, government, media and some of UK’s and a number of the world’s leading railway influencers.

Over the past five decades, BCRRE has grown to become an internationally recognised centre with world-leading expertise and to mark this occasion we celebrated our 50th birthday in February. It was a close knit gathering with colleagues within our railway centre.

The end of spring brought the opening of the multi-million-pound Rail Accelerator and Innovation Solutions hub for Enterprise (RaisE) business centre in Goole. We later found ourselves on the centre stage of rail research and development as the co-hosts of the World Congress for Rail Research. With up to 1000 attendees, 300 speakers, 340 unique sessions and over 600 paper submissions, it was wonderful to see a truly invested interest in rail R&D under one roof. We were delighted to partner with RSSB once again to deliver something truly extraordinary.

Our work across Enterprise and Innovation has brought a large number of projects successfully to life and indeed delivery. Our work as a part of the UK Rail Research and Innovation Network has seen us work with industry partners to deliver a number of invaluable projects. Over the last 12 months BCRRE has signed 6 framework agreements to grow research, development and innovation activities.

We have maintained our international perspective and continued our collaboration on projects with global partners, with initiatives driving forward in Brazil, UN, Railways, Ethiopia, Argentina, South East Europe, and Sub – Saharan Africa.

Our most recent initiative is BRIC, the BCRRE Rail Innovation Cluster, a one-stop knowledge hub for SMEs to benefit from - it is industry-facing, staffed by supply chain experts with sector knowledge and more importantly sector connections. Having assisted SMEs for over 20 years, we are now offering a full package business support network to continue our offering on a larger and wider scale. Watch this space in 2023, there is plenty more to come!

Highlights during the year include:

- HydroFLEX showcased at COP26, as in service passenger train making trips from Glasgow Central round the Cathcart Circle with a capable of a range on hydrogen or more than 300 miles
- Celebrated 50 years of BCRRE
- Successfully hosted and delivered the 13th World Congress on Rail Research with partner RSSB
- Signed six framework agreements with SMEs, OEM’s and academic institutions to grow research, development and innovation activities
- Won Gold in the Green Impact Award
- Launched BRIC, the BCRRE Rail Innovation Cluster to widen the reach of our business support offering.
Professor Paul Plummer
Railway Strategy

You’re only “new” once and having joined the university a year ago, I’ve been reflecting on the importance what we do in the context of our industry.

It’s an obvious fact that a fundamental purpose of our research and education is to enable the railway industry in the United Kingdom and oversees to innovate and deliver better outcomes for customers, the economy and the environment while also enabling better opportunities for railway people.

In the last year the global railway industry and its supply chain have played a key role in aiding recovery from pandemic and have started to respond to resulting changes in work and travel patterns. At the same time, an increased focus on climate change has reinforced the importance of rail to enabling net zero and highlighted the need for rail to improve its own sustainability. There are also much deeper and longer-term challenges and opportunities for the industry to improve customer experience for everyone and to provide better value for money. And, of course, all of this applies just as much for rail freight as it does for public transport.

Many of the industry challenges and opportunities are not new but they are arguably more important and more urgent. In Great Britain, as in many other countries, there are significant programmes of reform aimed at putting customers at the heart of decision-making and enabling innovation. I’ve been delighted to have seen the university playing such a big part in helping industry to respond to the growing challenges and opportunities.

The depth and breadth of research and innovation at Birmingham is truly impressive. And our priorities of digitisation, decarbonisation and skills are well aligned with industry needs. It’s been personally exciting to get involved in collaborations with other British universities to enable innovation and facilitate a focus on customer experience. The extent of Birmingham’s global impact through collaboration with other railways is also inspirational.

Finally, it’s a been a privilege to be part of what we do to educate the railway family at all levels and to develop next generation of diverse railway people who have the skills and ambition to enable the industry to deliver for customers. The prospect of further academic research, modelling and analysis in collaboration with the industry to inform real decision-making across the whole life-cycle and the whole rail or transport system with a focus on what matters for customers is exciting.

Professor Paul Plummer
Railway Strategy
The Centre of Excellence in Digital Systems at the University of Birmingham brings together existing academic and industry capabilities. It looks at new areas, supporting transformational change in rail technology across the globe.
Smart Monitoring and Autonomous Systems

2021-22 has been another busy year for the Smart Monitoring and Autonomous Systems team. While it was fascinating working on targeted practical deployments throughout the pandemic lockdowns, solving problems to keep nationally critical infrastructure operational. The lifting of the restrictions has allowed us to work with more of our industrial partners on a much wider range of exciting and challenging problems.

The SMAS team has been out and about designing and deploying major instrumentation and monitoring campaigns from one end of the nation to the other. Working with Network Rail High Speed and Eurostar, the team has been identifying and evaluating a range of track issues and providing insights into how best to target maintenance activities. Building on the relationship, minor augmentations to the instrumentation have allowed the team to pinpoint and diagnose rolling stock issues, and targeted site visits have allowed them to use novel sensing solutions to quantify wear and damage to the infrastructure. Bringing in our partners at Hitachi, a bespoke trackside measurement campaign provides the counterpart trackside measurements allowing consideration of both sides of the wheel rail interface, and evaluation of novel visual and acoustic measurement solutions.

Heading west, the SMAS team has been developing air quality assessment solutions for RSSB on the South West Railway, and looking at inertial based track geometry evaluation with Hitachi on the Great Western. Further north, they have spent weeks embedded with Hitachi in their facilities in Doncaster and Edinburgh looking at vehicle subsystems, and even been up to Inverness working with our partners MoniRail and Unipart Rail on a trial for Network Rail and ScotRail. 

Dr Edward Stewart
Senior Lecturer
Smart Monitoring and Autonomous Systems

Back in the UKRRIN Centre for Excellence in Digital Systems, the SMAS team jointly hosted one of the technical visits for the World Congress on Railway Research, and the 5th Plenary meeting of the Harmotrack project – a worldwide consortium for track inspection and maintenance spanning 40 countries. In the labs, the SMAS team have been continuing their ongoing work on novel sensing concepts and looking at various vehicle and infrastructure subsystems for partners such as Hitachi and Siemens. They continue to support Network Rail with their European research activities undertaking projects on vehicle and asset positioning and novel switching concepts as part of the In2Track series of projects. The team’s autonomous systems work is also expanding with the use of robotics for active sensing and maintenance rather than just passive inspection. Finally, as extensive users of electronic components, the SMAS team have felt the challenges of the global supply chain; but have been working with our DigiRail colleagues to support and develop SME and supply chain interests and support growth throughout the rail sector.

Looking forward to 2022-23 the SMAS team expects to continue their field deployment work. Initial trackside scoping visits are anticipated to develop into full-scale deployments for their acoustic monitoring capability; and a proposal has been submitted to expand some of the vehicle-based monitoring solutions through incorporation of models developed by some of our academic UKRRIN partners. The autonomous systems work will continue to develop, both in house through the university’s appointment of a chair in robotics and artificial intelligence, and as part of the RaisE initiative with our partner Siemens in Goole. As the UKRRIN Centre for Excellence in Digital Systems continues to grow, with more test facilities coming online, so does the SMAS team’s ability to support our UKRRIN partners and the wider industry supply chain. Outside the CEDS facility, the SMAS team are also excited to support the testing branch of the UKRRIN initiative with the development of the Global Centre of Rail Excellence in Wales.
Our work around the theme of data has continued the develop strongly during the 2021/22 year and includes not only the delivery of specific research projects but also support for the industry via involvement with key groups including RSSB’s DISIC and the Rail Data Council.

Our activities in the machine learning space have largely built on the foundations put in place in 2020/21, with continuing EU-funded activity around the development of data-driven models for prediction of changes in track geometry, and further work on the modelling of delays to services across transport modes. We’ve also developed this area, setting up new PhD studentships to explore the possible applications of the technology in signalling.

In May we hosted a Data Study Group (DSG) in partnership with the Alan Turing Institute. This week-long activity gave us the opportunity to bring together a team of the very best of the UK’s Artificial Intelligence and Machine Learning researchers, drawn from the Turing Institute’s network, to perform blue-sky research on a complex, real-world condition monitoring dataset provided by Siemens Mobility. The Turing DSGs are a great way to get some quick insights into datasets that companies hold but perhaps don’t fully understand, and we look forward to supporting more of these events in 2023.

Digitalisation is an important part of our education offering, and this year we’ve successfully concluded the pilot of our new PGCert programme in Digital Railway Leadership. Aimed at senior leaders from across the industry, the programme provides an opportunity to learn about and discuss the implications of digitalisation in different areas of the business. Study tours running throughout the programme enable participants to see what other railways in Europe are doing to deliver digitalisation of their networks, and to share challenges and experiences. We’re aiming to open admissions to the programme for a new cohort later in 2022, with delivery planned to start early in 2023.

In the cyber security space, we’re working closely with our UKRRIN partners on how we can bring best practice and understanding from the Information Technology domain to the Operational Technology that powers our railways (e.g. secure design of rolling stock). Key to this approach is thinking about railway assets not only as isolated devices to be protected but also as part of the wider railway system, with all the interconnections that entails. We’ve been active internationally in this area, supporting production of a guidance document for the UN ESCAP region on the challenges their rail systems face from cyber-attacks, and starting work on a new project to transfer our existing UK experience to the US railroads.

In partnership with the university’s specialists on mixed, augmented and extended reality, we’ve begun looking at what these technologies have to offer the rail industry, with a particular view towards the visualisation of complex data sets and delivery of improved situational awareness for control staff. Work in this space will tie in with ongoing activity around the understanding of passenger flows in real-time, which we’ve been developing as part of the recently completed TravelXR project.

Finally, we’ve extended our work on distributed ledger technologies to ticketing, starting a new EU-funded piece of work looking at how the technology can help the industry more easily provide ubiquitous ticketing solutions, both within rail and across modes.
Condition Monitoring and sensing

Our capabilities, that sit within the theme of Future Railway Systems, Operation and Control, continue to go from strength to strength and in the last year we have enjoyed working with Siemens on a railway communication project, CRRC Sifang High Speed Maglev on a control system design optimisation project and HS2 resilience simulation and timetabling.

One of our major breakthroughs of the year is with Network Rail, West Midlands Trains and West Midlands Rail Executive who have agreed to support the West Midlands Digital Twin project led by BCRRE to provide railway operation digital twin systems for the West Midlands area. Watch this space.

The research outcomes of our ongoing and new projects have the potential to be applied to global railway industry to enhance the impact on railway system modelling and simulation, traffic management and control. Our major contribution to railway operators is to try their ideas in the virtual world before they are implemented in the real world, allowing for optimisation of services, efficiencies and system-wide control. Underpinning some of this work, BCRRE also leads the EC Shift2Rail project PERFORMINGRAIL – next generation railway train control system (moving block systems) research and development.

UKRRIN

The UK Rail Research and Innovation Network (UKRRIN) is a powerful collaboration between academia and industry, aiming to provide a step-change in innovation in the sector and accelerate new technologies and products from research into market applications globally. It is structured around three Centres of Excellence (Digital Systems, Rolling Stock and Infrastructure) formed by a consortium of universities and a fourth Centre of Excellence in Testing, which is a collaboration with existing industry testing and trialling facilities such as Network Rail’s Rail Innovation and Development Centres.

The University of Birmingham is the lead academic partner for UKRRIN and also leads the Centre of Excellence Digital Systems.

The UKRRIN Technology and Innovation Hub opened in at the Unipart facility in Doncaster on 24th September 2021. This new Hub will support the sector in translating academic research and innovation to solve strategic industry challenges and to enable and develop the next generation of products and services. The Hub will have a particular focus in supporting SMEs, both those established and new to the industry. In addition to the hub activities, the University of Birmingham is working closely with Unipart to deliver SME support via Digi-Rail in the Sheffield Region.

UKRRIN partners have contributed to the update of the Rail Technical Strategy refresh, which identifies progress towards the industry functional priorities, as well as enabling greater collaboration across industry and to inform the R&D investment pipeline.
The Birmingham Centre for Railway Research and Education (BCRRE) has launched the Centre of Excellence in Rail Decarbonisation, focused on supporting industry and government to lead research and develop the solutions that will deliver rail decarbonisation through six of our core capability areas.
Climate Adaption and Rail Resilience

Alongside mitigating the scale of climate change through decarbonisation it is critical that we adapt railway infrastructure and operations to be resilient to climate change impacts. Our group has continued to work closely with the Rail Industry through BCRRE staff secondments to stakeholders and research project collaboration. On the international stage we have been delivering research impact through the dissemination of our work across multiple projects.

The outputs of the Foreign, Commonwealth and Development Office (FCDO) funded 5-year High-Volume Transport (HVT) Applied Research programme were presented to an international audience at the UN COP26 Conference held in Glasgow. The Adaptation for Transport Resilience to Climate Change (AfTR-CC) policy guide has also been presented at the global challenges forum held in Birmingham in May this year. As part of the World Congress on Railway Research (WCRR 2022) proceedings this work was presented alongside outputs from the European Regional Development Funded project Strengthening Infrastructure Risk Management in the Atlantic Area (SIRMA).

In addition to this, the 4th SIRMA Workshop took place at the University of Birmingham alongside other technical visits as part of the WRCC programme. This one-day event brought together experts from around the world to discuss some of the final outcomes of the SIRMA project.

Aerodynamics

Railway aerodynamics is covered by a team of four academics and one research fellow from the Wind Engineering and Vehicles Aerodynamics research group. The team run two major experiment facilities: the Transient Aerodynamics Investigation (TRAIN) rig based at the RTC Business Park in Derby, and the Atmospheric Wind Tunnel in the Civil Engineering laboratory on the Edgbaston campus. A broad range of academic and industry research is carried out by the group, covering full- and model-scale experimental studies, as well as complex numerical simulations utilising the University of Birmingham BlueBEAR computational environment, in the areas of aerodynamics and wind engineering.

The group are currently conducting a range of fundamental and applied research studies, utilising the core team expertise and facility capabilities. In line with the aims of the Centre of Excellence for Rail Decarbonisation, the group has been successfully working on RSSB project ‘T1234 – CLEAR2 Air Quality on Trains - HVAC and Exhaust Interactions Study’ to understand the dispersion of exhaust pollutants from diesel rail vehicles, through characterising interactions with the aerodynamic flow. The team have developed a novel computational methodology to support the rail industry to accurately model exhaust dispersion around diesel trains which was published by RSSB.

The team have also been considering the effects of wind induced forces on overhead catenary systems, to support Network Rail in the development of new standards on overhead line equipment. The project has primarily focused on computational simulations to explore the forces acting on specific cables for a wide variety of situations and the implications these have on the wider system. Results have also been validated using our wind tunnel facility.

A further on-going project utilising the unique approaches offered by the TRAIN rig facility is that of EPSRC V010689 - The aerodynamic interaction of platooning and overtaking vehicles. This research is considering the aerodynamic flow development associated with autonomous vehicles travelling in a platoon configuration and potential aerodynamic instabilities which could be created for other road users. Additionally, the facility is also set to host researchers from elsewhere in BCRRE again, following the successful publication of last years work by Prof Roger Dixon and his team to understand RFID tags and readers.

Dr David Soper
Leader in Vehicle Aerodynamics

Prof. Andrew Quinn
Atmospheric Science and Engineering
Sustainable Traction Systems

HydroFLEX was showcased to the world in Cop 26. HydroFLEX 2.0, showcased at COP26 as a fully functioning train, capable of a range on hydrogen or more than 300 miles, and limitless on overhead electrification. This vehicle paves the way for full scale deployment of hydrogen trains which will be introduced on the GB mainline network over the coming decade. Thereby ensuring the long-term sustainability of the rail system as we move towards net zero.

Freight decarbonisation is possibly the most challenging for the rail sector. Diesel freight vehicles undertake arduous duty cycles and have high power and energy demands. The traction group are tackling these problems on multiple fronts, firstly, existing combustion technologies can be adapted to run on more carbon neutral fuels, and our group are actively investigating a range of possibilities. These include ammonia, e fuels, gases, and cryogenic liquified fuels. There is a wide range of potential solutions and it is important that the rail industry is dynamic and agile enough to embrace the emerging technologies. Our efforts on lower power locomotives are currently focused on the shunting scale. To this end we are converting a class 08 to run on hydrogen and provide shunting services to the Severn Valley railway. This project will demonstrate the commercial viability of freight locomotive conversion at the lighter duty end of the market.

The modular nature of the propulsion system being installed into the class 08 is scalable and can be sized for more arduous duties on larger locomotives. The development of hydrogen trains has proceeded at pace and vehicles are now being offered by the majority of OEMs. However, the other less visible aspects are somewhat lagging. For example, the development of standards, for both the on board and wayside systems are lagging behind. Our group at BCRRE are coordinating efforts to bring the hydrogen rail community together to enable best practise to be shared.

BCRRE is well placed to provide a forum for the ongoing development of hydrogen rail and we plan to develop the community as each scheme develops. Scot rail, for example, has already set out its timetable and agenda for the introduction of its hydrogen Fleet, and we can easily expect other regions to follow their lead in the coming months.

Geotechnical Engineering and Asset Management

During the year, the group completed successfully its two Network Rail projects to (i) develop a tool to predict the rate of change of railway track alignment (fixity) and (ii) identify and use innovative low maintenance materials for drainage components. The team continued its work with Network Rail on track drainage failure risk.

The track fixity work developed a framework for data integration and a mining tool, which can determine track fixity parameters for any given section of track. Track movement is assessed by LiDAR point cloud data and fixity is described by the direction of track movement relative to the plane of rail and the rate of the movement over time. A data mining algorithm was integrated into the framework to predict the values of those parameters, given a very large amount of heterogeneous data in the area. The importance of the work is that it will improve the accuracy and reliability of Network Rail’s gauging assessments and thereby help it to meet its obligations to the Office of Rail and Road in CP6.

The innovative low maintenance materials project for drainage components has resulted in a proof-of-concept solution to Technology Readiness Level (TRL) 4. The solution consists of a synthetic evapotranspiration system what can move water from the track subgrade to the cess area and from there by capillary action and transpiration/evaporation. The proof-of-concept system has been demonstrated to be effective in a laboratory environment. The importance of this innovative approach is that it can maintain the railway track subgrade at a constant moisture level, thereby preventing seasonal issues to do with changes in subgrade strength and associated differential track settlement. Thus preventing the need for unplanned maintenance.

The work on track drainage failure risk has resulted in the publication of an article in the American Society of Civil Engineer’s (ASCE) Journal of Infrastructure Systems, entitled “Condition Modelling of Railway Drainage Pipes” Nour Aljafari; Michael Burrow; Gurmel Ghataora; Mehran Eskandari Torbaghan and Jamil Raja (2022).
Sustainable Infrastructure

We have been looking at eco-friendly construction and railway materials that enhance cleaner and lower carbon infrastructure; low-carbon materials including high-damping and self-healing concrete, 3D printing composites; and self-sensing materials that can monitor cracks and damage. Combining structural mechanics and the principles of dynamics with practical experimentation using advanced simulations, artificial intelligence and data science, we have built up a clearer understanding of how infrastructure failure happens and how to prevent or mitigate against it. Much of our recent work has been with the ambition of enhancing the service life of infrastructure and reducing waste to minimise whole-life cost, energy and Carbon footprint. Along the way we also contributed to the development of two ISO/BSI standards for railway concrete and plastic sleepers.

The role of power electronics towards “net zero” in railway transport

Electric railways are large consumers of electricity and require strong power supplies from the power grid. However, the progressive penetration of renewable power sources is changing substantially the characteristics of traditional power grids and there will be in the future a much higher need to control the load and generation profiles. Power electronics is the key underpinning technology to achieve that and it is expected that their use for rail electrification systems will considerably grow in the near future.

The BCRRE power electronics team is currently undertaking the H2020 E-Lobster project with 8 EU partners to improve synergies between the rail traction and power distribution networks using soft open point converter. A prototype has been developed and currently under test in the lab and will be installed for real-life demonstration in Metro de Madrid, Spain, in December 2021.

Also, we are working with several industrial partners to develop a new power-converter based battery chargers for EV connected to the 25 kV electrification network and our lab-based demonstrator is currently under testing and ready for March 2022. Finally, our Shift2Rail work on the ground-breaking research on Medium Voltage DC electrification systems, in partnership with the University of Cluj-Napoca, Romania, has entered into the final stage, with the construction of a lab demonstrator that will be completed in April 2022. Our interim results have been successfully presented at a join workshop of Shift2Rail projects on railway electrification systems.

Finally, work is underway to demonstrate in the lab a new 3x25 kV electrification system that minimises the imbalance on the grid and hence, mitigate the need of a strong power supply. An international patent has been recently granted on this and the group will now work to engage industry for further development.
Education and training are fundamental to effective working in any industry, and the rail industry is no exception.
BCRRE and the new National College for Advanced Transport and Infrastructure

In May 2021 the new National College for Advanced Transport and Infrastructure (NCATI), a flagship further education college with state-of-the-art campuses in Doncaster and Birmingham, became part of the University of Birmingham (UoB) family. Since then we’ve been welcoming new colleagues including Principal and CEO, Ian Fitzpatrick, together with business development, marketing and teaching staff.

Not only does this mean new faces around both campuses, but it has brought significant opportunity to work closely together across BCRRE, the wider university and the NCATI team to win new contracts and launch new training, study and skills-development programmes. NCATI is now going places… check out the new video on the home page of www.ncati.ac.uk.

If you were reading our 2019-21 report you will remember we aimed to build on our combined expertise, strong industry links and rail technology to develop a suite of high-quality education and training opportunities where we can provide a distinctive local and national offering across the rail, transport and infrastructure sectors. This has certainly been our focus and have built on NCATI’s established suite of academic and vocational programmes to include new Foundation Degrees in Civil Engineering and Civil & Railway Engineering and to extend further the range of each type of programme on offer.

The brand-new Foundation Degrees follow the content of UoB’s engineering programmes and are validated by the university. This means that not only do NCATI students learn the same high-quality content as their UoB counterparts, it also means they can obtain a UoB qualification after 2 years or, better still, transfer directly into the 3rd year of the UoB BEng to achieve an accredited degree. With part-time study as well as a full-time option, this means we can welcome people wishing to retrain or combine work and study as well as those embarking on student life – widening participation and welcoming students who might not otherwise consider studying for a higher education qualification.

The strength of a college such as NCATI, where we have a focus on specific industry sectors, means we can concentrate on offering programmes which a regular further education college might consider niche. One initiative is to develop courses where learners can immediately use their knowledge in the workplace for immediate impact both on the individual and for the employer. Our first “work-ready” programmes include a Rail Academy, an 8-week course which gets learners quickly into work as track maintenance operatives, collecting two Level 2 diplomas along the way, together with PTS certification – what could be more “work-ready?” We’re in the throes of other programmes for “work-ready” people so watch out for exciting announcements!

As well as bringing new, work-ready employees with the knowledge and skills needed to make an impact as quickly as possible, we’re supporting companies who want to progress staff throughout a development journey. With this in mind, we are working on suites of apprenticeship and short-courses which will bring people from Level 2 and 3 operator-style roles right through to technical experts, principal engineers and senior leaders. This is made possible because of the unique relationship between UoB and NCATI. We now can bring people through a rail technical development journey, starting with Level 3 Rail Engineering Technician apprenticeships, through the Levels 4 and 5 to the Level 6 integrated degree apprenticeship, and then on to UoB for the Level 7 Rail & Rail Principal Engineer apprenticeship. We’re even embedding the Foundation Degree into the Level 5 Rail & Rail Systems Engineer apprenticeship to give extra value to this important occupational standard.

We’re not just about rail and we are now developing programmes and learner-journeys for the infrastructure and wider transport sectors. UoB already offers the Level 7 Geotechnical Engineer integrated degree apprenticeship and we can support learners at Level 5 with the new Foundation Degrees and UoB’s BEng and MEng study in civil engineering, and with BTECs and HNC/Ds in Engineering and Infrastructure. This kind of partnership approach is just the start of our sustainable and inclusive future.

As we go forward into 2023 we will have exciting and significant new opportunities where our sectors’ employers and prospective employees will continue to benefit. New facilities and other new collaborations with industry and across UoB mean NCATI is going places and is inviting you to come along too.
Enterprise and innovation at BCRRE undertakes two core roles, the first to provide commercial and professional services support to our research and education activities. The second is to engage with the global rail industry to foster collaborations and to provide enterprise and innovation support to organisations.
Thank goodness for acronyms . . . so just what is the ‘BRIC’?

The Birmingham Centre for Railway Research and Education (BCRRE) Rail Innovation Cluster (RIC), or ‘BRIC’ for short, is being launched at InnoTrans in Berlin during September 2022 – it has a simple vision, ‘To become the home of innovation for the SME base in the Rail Supply Chain able to deliver greater value and innovative capability at home and abroad’ . . . clearly, this capability cannot start up overnight and there has been much work over the years within the BCRRE to get us to this point. Significantly, we have been assisting SMEs in one way or another for 50+ years; however, it has not always been entirely obvious from the SMEs’ perspective that we are ‘open for business’ in terms of working lower down the supply chain tiers . . . our help and assistance will also include offering SME ‘newbies’ to rail our proven ‘Get into Rail’ programme.

The BRIC builds on the success, and legacy, of the Rail Alliance which was established in 2009 to be a disruptive trade association to assist SMEs to enter the Railway Supply Chain whether as startups or through diversification from other sectors (mainly from, but not limited to, automotive, aerospace, defence, advanced manufacturing and med tech). That concentration on developing and assisting SME capability remains and we are supporting more SMEs than ever before through joint projects locally, regionally, nationally and internationally.

In short, the BRIC is a one-stop knowledge hub for SMEs to benefit from, it is industry-facing, staffed by supply chain experts with sector knowledge and – more importantly – sector connections (vital for our maintaining our continuing success with releasing ‘spin out’ companies). The BRIC offer to the client side of the railway (framework contractors and OEMs) is to assist them by bringing new and vibrant SMEs to their attention, thereby invigorating the supply chain, and delivering the innovation that our sector so badly needs.
DIGI-RAIL is a business support programme, part-funded by the European Regional Development fund, to provide innovation support to SMEs for the development of digital products, processes and services for the rail industry.

The aim of the programme is to solve challenges within the railway sector and access the increasing number of digital rail commercial and research opportunities that currently exist in the UK and internationally. With a focus on SMEs in the West Midlands and Sheffield City Region, the initiative offers numerous benefits to members including (but not limited to)

- Access to world-class technical expertise from the university
- Demonstration infrastructure
- Bespoke 1-to-1 consultations
- ‘Get into Rail’ workshops and seminars
- Collaborative research projects

Since its official launch in March 2019, the DIGI-RAIL programme has recorded tremendous success. With over 200 SMEs engaged so far, it remains well on track to enabling regional businesses to take full advantage of the opportunities the digital railway brings.

The programme is currently providing R&D expertise to beneficiaries for the development of new products and services for condition monitoring of rail infrastructure, light rail systems, railway assets maintenance, and many more. The programme is also supporting SMEs to develop data-driven solutions and improvements to tackle key challenges faced in the rail sector.

**Get into Rail**

BCRRE partner with GBSLEP Growth Hub to deliver rail and manufacturing SME account management across the Birmingham and Solihull area. This includes Get in to Rail, working with key partners inc HS2, WMCA to raise awareness of rail and manufacturing projects, whilst supporting SMEs in their development for diversification, innovation and growth.

The UK’s Railways are as critical to the economic success of our country today as they ever been. With unprecedented levels of UK government investment in national and regional rail infrastructure there has never been a better time for SMEs and non-rail companies to explore entering the Rail Supply Chain as a way to grow business and ensure sustainability for the future.

BCRRE offers a ‘Get into Rail’ programme for SME’s located within the West Midlands, GBSLEP, Sheffield City Region, Derby, Subject to confirmed eligibility and completion of Project Documentation.

The sessions aims were to ensure all Participants understand of the rail sector architecture, Participants gain an awareness of Great British Railways and transition plans, Participants gain an increased understanding of rail challenges and opportunities and receive support developing their individual Get into Rail action plan.
32 SMEs have received support via the DIGI-RAIL (SCR) Project, and we are looking to support a further 39+ SMEs by June 30th 2023. Themes include Decarbonisation, Digitalization and Energy, as well as providing Rail Industry market intelligence, and ‘Get Into Rail Workshops’ for businesses considering entering rail sector supply chains with their product or service.

We have worked closely with a number of affiliated and local businesses to showcase the breadth of our offering and expertise, collaborations have been formed with:

British Stainless Steel Association (BSSA)  |  Corvis Communications Limited
Nota Bene Consulting Ltd  |  Paintman Paint Limited  |  Pass Logistics Ltd
Peak to Peak Measurement Solutions Ltd  |  Railcargo Liner Ltd  |  The Floow Ltd
The Orange Train Wash Ltd  |  Tribosonics Ltd  |  3Squared Ltd

Pass Logistics Ltd and The University signed a Memorandum of Understanding (MoU) to explore ways of moving heavy freight off our road systems and into the rail network, which is key to reducing the carbon footprint of freight transport. Researchers in the University’s Centre of Excellence in Rail Decarbonisation, within the Birmingham Centre for Railway Research and Education (BCRRE), are working collaboratively with Pass Logistics experts committed to moving traditional road container haulage onto the railways. Approaches could include devising ways to help companies understand their carbon output and the relative impacts and costs of alternative approaches.

The University and Peak to Peak Measurement Solutions (PPMS) Ltd signed a Memorandum of Understanding (MoU) to further their commitment to developing embedded sensor technologies for predictive maintenance, in an energy-efficient way, to extend the operational lifetime of dynamic machine elements. Researchers from BCRRE advised on different concepts for embedded sensor hardware designs, as well as consulting on a PPMS Ltd Innovate UK Funding Proposal, namely ‘SBRI Global Rail Export Innovation for Australia, Canada and India’. PPMS Ltd were successful in their bid application, which enabled them to collaboratively explore overseas market and export opportunities.

The European Railway Clusters Initiative (ERCI)

The ERCI partners have been working hard towards achieving the goals of two big projects: S-ACCESS and STARS. Funded under the COSME programme of the EU, the partners connect the ideas and interests of over 2,000 small and medium-sized businesses in the industry. They help the member companies to grow – through improved access to European partners and customers, accelerated technology transfer and joint marketing in- and outside of the EU.

For the STARS project BCRRE and the other partners have been collecting data from over 100 SMEs to identify SME needs and obstacles in all aspects related to the uptake of advanced technologies for the delivery of Railway-related innovations by SMEs. STARS ultimate goal is to concretely support such SMEs to find solutions to their needs via the use of Advanced Technologies (new solutions for the market, improved internal processes, etc.). Once the data is analysed, SMEs will be receiving free training on the drivers helping their company adopt advanced technologies and be invited to Hack & Match® events, where challenges coming from respondent SMEs will be addressed to find solutions via the Hackathon part and the Matchmaking part with Tech-savvy SMEs suitable to provide such solutions.

Similarly, for the SACCESS Project (SMEs ACCESS to international public procurement in railway), a survey was conducted in order to understand the international experience and difficulties that SME sector is facing in accessing foreign markets. As a result of this Survey, SMEs will be able to participate in the S-ACCESS project activities supporting their internationalisation. In particular, the project aims to develop tools to help SMEs of the Rail Supply Industry participate in Public Procurements in USA, Canada and Norway.
We have worked in all non-Arctic continents.
Industrial Activity

It has been a busy year with lots of exciting activity carried out by the Industrial Fellows at BCRRE. This included working with new people as well as continuing strong collaborations with existing partners.

There have been a number of projects that the Industrial Fellows have provided additional support (although Kevin Blacktop will tell you about the key projects that his team has helped to deliver).

Overall, the team has worked on proposals valued at £10.3M from which ~£1M have been commissioned working with DfT, ORR, HS2, and NR. We were recently awarded six Network Rail sponsored PhDs worth £222,000 starting Autumn 2022. These PhD research projects are studying critical areas for Network Rail:

1. Digital Twins of Power Converters Connected to Network Rail’s AC Traction Power Supply
2. Geospatial Utility to Assess the Stability of Rail Vehicles Under Crosswinds
3. Mapping the Resilience of Green Transport Corridors to Strong Winds Effects
4. Operational Network Responses to Weather Events to Improve Future Climate Resilience
5. Maximising Ecosystem Services from Linear Forests Under A Changing Climate
6. Operational and Virtual Reality modelling of new service running

We have partnered with Jacobs, Arup and PA Consulting on three separate exciting opportunities for research and consultancy on behalf of HS2. These are for: Innovation Advisory Support, Phase 2A Design and Delivery Partner, Systems Integration and Railway Systems services.

I am supporting the delivery of a few transport related projects funded by the Foreign, Commonwealth and Development Office (FCDO) as well as industry sponsored ones. These are:

1. HVT047 Adaptation for Transport Resilience to Climate Change (ATR-CC) for LICs in Africa and South Asia Climate-resilient transport: The key output from this was a policy guide that enables providers of transport in low-income countries (LICs) in Africa and South Asia to strengthen the resilience of road, rail and urban transport infrastructure and services to climate change. Key findings from the project were presented at COP26.
2. HVT037 Climate Resilient and Sustainable Road Pavement Surfacing for Developing Countries (CRISPS) – the aim of this research is to determine the technical and economic viability of alternative climate resilience surfaces as an adaptation strategy for increased temperatures. Part of the work is determining the relative long-term performance of the epoxy modified binders compared to traditional bitumen. This research project will conclude December 2022.
3. Investigation of rolling stock structural integrity and the influence of track input forces for a rolling stock OEM. This investigation was satisfactorily concluded enabling the rolling stock OEM, the train operator and the infrastructure manager to collaborate on effective strategies that addressed the emerging challenges.
4. Efficient Engineering Assurance Target 190 for implementation of an Efficient Engineering Assurance process for Target 190plus Programme, which “sets out to achieve Signalling Equivalent Unit (SEU) rate savings throughout CP6 to reach the target figure of £190k per SEU and other benefits.” This is for Network Rail to develop new assurance processes that fit with new development processes such as T190. The outcome will produce the best assurance processes.

For 2022-23, the industrial fellows will be focussing on five areas:

1. Developing research and development opportunities with BCRREs UKRRIN partners bringing them to maturity. The activities will include getting framework agreements in place.
2. Working with academics and industry sponsors to develop and win EPSRC research projects.
3. Build on the collaborations and relationships that BCRRE has with University of Birmingham’s schools and colleges and UK academic institutions to develop and deliver research opportunities for the railway sector.
4. Support, develop and build on relationships and collaborations internationally.
5. Explore emerging opportunities for research and development for the GB and international railway sectors and produce winning bids.
The future of Transport Systems

Despite the constraints of the global Covid-19 pandemic, the Birmingham Centre for Railway Research and Education (BCRRE) continued to expand its international reach with sustained efforts to help modernise railways around the world. Initially through the virtual domain, and then in person when restrictions were lifted, we engaged in a number of activities in most of the continents of the world.

Our team has moved to the final stages of the project HVT039 – Novel Traction Systems for Sustainable Futures in LICs in Sub-Saharan Africa. Funded by the Foreign, Commonwealth, and Development Office (FCDO), this applied research initiative is developing cost effective solutions to decarbonise railways in the African continent. Making them accessible and viable for those regions is a significant step-change in enabling financially constrained economies to reduce their GHG emissions without constraining their economic development. Our preliminary results were presented virtually at the Transport Evolution Africa conference in October/2021, and our final results will be presented in person at the 2022 edition in Durban, South Africa.

Also in Africa, we have been busy with capacity building programmes that can support the rapid development of the railway infrastructure in the region. Early in 2021, a team led by Professor Clive Roberts helped the Ethiopian Railways Corporation in mapping the capability gaps to develop their railway training academy. The work later delivered a roadmap for bridging those gaps in facility planning and programme content for the Ethiopian operator.

Later in 2021, I led the delivery of an online Continued Professional Development (CPD) programme for the Tanzanian Land Transport Regulatory Authority (LATRA). The programme upskilled more than 70 civil servants of the agency in two modules of Urban Transport Management and Safety, and Rail Infrastructure, Commissioning, Certification and Registration. With over 95% of the participants rating the programme as excellent, we can safely claim it as a success despite the travel constraints of the time.

The past year has also seen BCRRE broaden its institutional engagement beyond the railway sector, exemplified by the growing relationship between the centre and the United Nations. This included a number of expert projects for the UN Economic and Social Commission for Asia and the Pacific (ESCAP): on cybersecurity led by Dr John Easton and Dr Richard Thomas; and on rail decarbonisation led by Professor Stuart Hillmansen, Alex Burrows and myself. Following those, the group hosted a representative of the organisation, Mr Sandeep Jain, during the World Congress for Rail Research (WCRR2022), where the next steps of the collaboration were discussed.

WCRR was also the stage where BCRRE showcased its research activities in South America. Dr Cassiano Isler from the University of Sao Paulo (Brazil) presented the results of the joint research with me on demand forecasting methods for railway networks. The project was jointly funded by the University of Birmingham and the funding agency of the state of Sao Paulo (FAPESP). With an MOU between the universities of Birmingham and Sao Paulo, more projects are being drafted with Dr Cassiano Isler, who is also an Honorary Research Fellow at BCRRE.

Finally, and further demonstrating the presence of the centre in South America, Prof Clive Roberts, Achila Mazini and I hosted the president of the Latin American Association of Railways (ALAF), Mr Jose Villafane, to the UKRRIN building in July 2022. This visit builds on one of the two strategic MOUs that BCRRE holds in the region (the other being with the Brazilian Ministry of Infrastructure), and will be key to establish a number of research and capacity building activities in the continent.

We are both proud and excited with the growing international engagement seen at BCRRE. Working in several continents, often simultaneously, widens our knowledge and expertise and furthers our leadership position in cutting-edge research that delivers innovation around the world. The new UOB campus in Dubai stands as an important hub that will help us deliver these more closely. With most of the constraints of the pandemic being over, we can only expect our activities to grow even more, helping all countries in their paths to sustainable development through better railway systems.
Transport Systems and Climate Change

The research that we undertake within BCRRE supports the rail industry as well as addressing big global challenges. Starting in September 2022 Dr Rachel Fisher will be delivering a Natural Environment Research Council (NERC) funded Knowledge Exchange Fellowship (KEF) in partnership with key rail and transport stakeholders. The project aims to develop individual and organisational capability to adapt public transport systems to climate change by facilitating knowledge exchange through the creation of a climate change adaptation knowledge pipeline. The project will critically evaluate the role of higher education as well as continued professional development in ensuring our engineers have the key knowledge, understanding and tools they need to adapt to a changing climate.

Dubai

I have been contributing to the development of the new University of Birmingham Campus in Dubai. The new campus, which opened on 21st April 2022, can currently support up to 2,900 students and will eventually be able to support up to 4500 students and feature innovative teaching and research space to encourage cross disciplinary working. Learning spaces incorporate digital technology and a student hub supports student needs across teaching and well-being. I was closely involved with the specification, procurement and installation of AV and Lab equipment and staff recruitment. The campus now has E-Labs, Dry Labs, Wet Labs and a General Workshop, which will allow the campus to be self-sufficient and provide a high quality learning environment for students and staff.
Britain's first mainline-approved hydrogen-train made its first, passenger service appearance in Glasgow to demonstrate its role in driving the green industrial revolution at the COP26 Climate Change Summit.

Developed by engineers in the University of Birmingham's Centre for Railway Research and Education (BCRRE), in partnership with rolling stock owner and asset manager Porterbrook, the HydroFLEX train is now ready for the next stage of its journey providing zero-emission passenger transport services.

Experts at BCRRE have been involved every step of the way in the design and development of the hydrogen technology and its application to the railway. Since HydroFLEX was first conceived in 2018 the project has developed rapidly from the collaboration agreement in September 2018 to full mainline test runs in September 2020.

In just three years the team (with funding from Innovate UK) have developed and proved the detailed design of a fully functional hybrid hydrogen fuel cell system and battery system on board the train. They were able also to design the architecture of the power control system which operates the fuel cell and energy storage system in an optimal manner. More recently the team have worked to modify the design of the hydrogen power pack enabling it to be fully integrated into the train system.

Hydrogen and battery technology, as demonstrated on our HydroFLEX train, is key to supporting the UK’s plans for a Green Industrial Revolution and delivering on our Net Zero commitments. This project has showcased our capabilities at the University and our technology is now proven, demonstrating that we can rapidly decarbonise the railways. We are thrilled to be able to share this progress at the United Nations COP26 Climate Change Summit.

HydroFLEX also draws on expertise from a wide number of industrial partners. This collaborative success story is now well on course to make a significant contribution to the Government's rail decarbonisation aims. Beyond HydroFLEX, researchers at BCRRE are identifying other areas where their hydrogen fuel expertise can be employed to deliver low carbon transport globally. One project already underway will see the team developing new traction systems for sustainable railways in low-income countries in Sub-Saharan Africa.
Over the past five decades, BCRRE has grown to become an internationally recognised centre with world-leading expertise in areas including railway control systems, cyber security, power systems, climate resilience, sustainable traction systems and aerodynamics, while its flagship hydrogen train project, was showcased at the COP26 global summit last year.

Luisa Moisio, Director of Research and Development at Rail Safety and Standards Board (RSSB) said; over the years RSSB and BCRRE have successfully worked together on a wide range of research topics, including the future of traffic operations, modelling decarbonisation options, and condition monitoring. The new knowledge delivered particularly in these areas has been extremely influential in shaping progress in GB and beyond. At present the RSSB and BCRRE teams are working very closely on all the preparatory work needed to co-host the 13th World Congress on Rail Research, taking place in Birmingham in June 2022. This will provide to our two organisations and the rest of the GB research and innovation community the best platform to showcase capabilities and to learn from others.
The multi-million-pound Rail Accelerator and Innovation Solutions hub for Enterprise, (RaisE) business centre in Goole is now officially open.

The striking three-storey building, with a prominent frontage to Tom Pudding Way, includes spacious, modern conference rooms, smaller ground floor meeting rooms, communal break-out areas and free on-site car parking for occupants and visitors. A welcoming communal café hub that will act as a focal point for the business park will also be operational from June 2022. This space is available to let to small and medium sized enterprises (SMEs) in any sector and is not exclusive to those involved in rail. It is also estimated that the business centre, via its occupiers, will create over 90 new job opportunities now businesses are beginning to move in.

The second floor is now the office base for Siemens Mobility, who are the catalyst for creating the Goole Rail Village. Their presence within RaisE and the new rail factory site opposite the business centre will create up to 700 new jobs. The University of Birmingham is home to the Birmingham Centre for Railway Research and Education. Europe’s largest university-based specialist railway research, education and innovation centre that provides; world-class research, education, and innovation to the global railway industry of which its engineers, academics and industry experts will have an office base on the first floor, at this new Goole business centre. The breadth of skills, facilities and reach at the University’s railway centre will enable businesses to diversify into rail and for those already operating in the sector further develop their products and services.

Phase two of RaisE will now follow on the same site and will be a £50m centre of excellence for rail and research and innovation developed between Siemens Mobility and the University of Birmingham.

"It really is fantastic to see the RaisE business centre in Goole become operational and this exciting project, alongside the rest of the ‘Rail Village’ is brilliant news for Goole and the surrounding areas. ‘The relationship between the three key stakeholders has ensured we now have an example of how the public sector, industry and academia can work together to ensure Goole continues to be shown as a town on the rise.’"

Cllr Jonathan Owen
Leader of East Riding of Yorkshire Council
The World Congress on Railway Research, hosted by RSSB and the University of Birmingham, saw delegates from across the global community championing technical development, advocating collaborations and inspiring the next generation of rail professionals to work together on the common challenges faced by railways. Topics discussed ranged from zero carbon trains to passenger experience to enhancing rail freight.

Rail Minister, Wendy Morton MP, delivered the Ministerial Address to the Congress as part of the first days' events. She said: “It was great to see delegates from across the globe championing innovation and inspiring the next generation of rail professionals.

“It was also wonderful to see the industry, academia and government all coming together to share ideas to reach our common goal of developing, decarbonising and driving forward the railway industry.”

As part of her visit to Birmingham, Ms Morton also toured the University’s new railway research facilities based in its new UKRRIN (UK Rail Research and Innovation Network) building. The facilities were established to support powerful research and industrial partnerships in digital railway engineering.

“Research and development is accelerating at fast speeds, with high-tech facilities and a strong focus on education, resulting in some remarkable collaborations,” added Ms Morton. “So, it was wonderful to see the facilities available in Birmingham which are directly supporting the railway industry, not only in the UK but overseas too.”

With over 300 speakers, 340 unique sessions delivered and over 600 paper submissions, tailored panel sessions and opportunities to network, it was wonderful to see a truly invested interest in rail under one roof.

Luisa Moisio Director of Research and Development at RSSB commented: “The 13th WCRR was a resounding success and I’m incredibly proud to see everybody’s hard work pay off. It was a fantastic week, with a varied mix of exhibitions, presentations, plenary discussions and technical visits on new railway research, development, and technical innovation.

“Through our research and development, building on the success of WCRR, RSSB is committed to helping the industry in Great Britain to make vital improvements that will increase the reliability, efficiency, and sustainability of the railway, delivering more value to its passengers and freight customers while maintaining its good safety performance.”

Mark Thurston CEO, HS2

As we deliver Britain’s new zero-carbon, high speed railway, we’re taking the opportunity to champion research and continually innovate in areas ranging from engineering to the environment. The World Congress on Railway Research was an ideal platform to share our experiences, while continuing to learn from international expertise. We hope that our interactive exhibition and involvement in the plenary discussion was as valuable for the international rail research community as it was for us. Equally, we were pleased to take delegates behind the scenes of the HS2 Curzon Street Station site, which will be at the heart of the new high speed rail network, ultimately helping to boost rail capacity and economic growth across the country, while providing a cleaner and greener way to travel.

The next World Congress is due to be hosted in 2025 by MxV Rail in the United States.

“MxV Rail is honoured to host the 2025 WCRR conference in colourful Colorado, USA. We look forward to welcoming delegates to the next WCRR event focused on advancing our industry toward a safer and more resilient global rail network.”

Kari Gonzales CEO & President at MxV Rail
The South East Europe Rail Research and Innovation Network

Founded by BCRRE with the Universities of Belgrade and Zagreb and the Rail Cluster for South East Europe, in 2020 to enable innovation and facilitate collaboration across the regional rail industry. SEERRIN brings together industry, academia and governmental bodies to drive growth and development of the regional rail industry.

Despite the restrictions during the pandemic, we built up significant interest with a number of regional university faculties, government ministries and infrastructure ministries signing up to support and grow the rail supply chain.

As part of building relationships for real and tangible activity, keynote speeches by Alex Burrows have been well received at the South East Europe Mobility Fair attended by several SEE Government Ministers and the UK Ambassador to Serbia, underpinning the true value of developing relationships with a common goal. He also recently (June 2022) spoke at a major regional rail conference in Ljubljana, Slovenia on the opportunities for rail innovation in South East Europe region. As a result of this activity several projects are currently in bidding/development stage, with results to land in 2023.
railway@contacts.bham.ac.uk
+44(0)121 414 2626
birmingham.ac.uk/railway
@bcree
linkedin.com/company/bcree

DECARBONISATION

DIGITALISATION

EDUCATION

INNOVATION