Results of Competition: SBRI: Innovation in Automated Survey Processing for Railway Structure Gauging, Phase 1

Competition Code: 1912_SBRI_NR_MMM_GAUGINGP1

Total available funding is £720,000 plus VAT (£864,000)

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
MobiBiz Ltd	ATLAS (Automated Track & Lineside Asset Survey)	£89,146	£89,146

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Gauging is a vital part of Network Rail's maintenance and operating of the railway. Gauging is the process through which Network Rail ensures adequate clearance between passing trains and lineside objects and structures. Currently, this process requires specialist gauging machines or via manual reviews of point cloud data captured from trains, drones or personnel operated laser scanners. The consortium of MobiBiz (Lead), BAE Systems and Jacobs Engineering Group will enhance the interpretation of point-cloud data. MobiBiz's cloud based ATLAS (Automated Track & Lineside Asset Survey) platform will be used to create an end-to-end automated pipeline of the following steps: 1. Automatically classify, detect and segment and locate trackside structures within a point cloud using deep learning. These structures include crossings, overbridges, platforms, underbridges, tunnels, viaducts, wall, signals, OLE supports, telecommunications structures and other line side furniture. 2. Automatically detect vegetation around trackside structures from point cloud data. 3. Use Artificial Intelligence techniques to interpret and analyse point clouds automatically and assist in gauging processing, cant, curvature and clearance. 4. Provide a Web based portal to visualise geo-references route overplayed with point cloud data and automated analysis to assist gauging engineers for visualisation, validation and cross-checking. 5. Integrate with existing Network Rail systems by outputting SC0 files and exposing an open API (Application interface) to facilitate integration with existing reporting systems, events and asset databases. Trainborne capture methods are now extremely efficient and accurate in capturing vast amounts of information in the form of point clouds. However the problem now lies in processing. Capturing terabytes of data makes the processing and subsequent analysing extremely slow, with much of the process taken up splitting the data into manageable chunks, cleaning up the chunks and classifying the data. ATLAS can automate this part, leaving more time for specialist Network Rail staff to actually review the outputted files and make informed maintenance decisions. These inspections can be carried out more frequently, spotting trends and issues as they arise. The processed data output from these inspections will be used to inform maintenance and assist with predictive maintenance planning and intervention. ATLAS also provides a visualisation platform, allowing Network Rail staff to compare point clouds of structures across multiple routes for current and historical data.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
GMV Innovating Solutions Limited	Smart Gauge - Automatic rail survey processing and gauging using deep learning.	£106,368	£106,368

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Project description - provided by applicants
This project, Smart Gauge, will use point cloud data to improve railway surveying and gauging techniques through automation. Our proposed system will automate work towards continuous and instant real time information on rail gauging. The current surveying regime may take place up to every 5 years, GMV plan to bring to market a system which will reduce this internval every 3 to 6 months. Possible future extensions of fidelity through the addition of components such as high precision (GMV proprietary) GNSS technology, and satellite imagery, will assure continuous efficiency after the project ends. We will gain a better perception of up-to-date market technologies and practices used for gauging through our partnership with TfL and Network Rail. We will work together to include expertise assessment and provision of real world data to boost our model performance during Phase 1. This progressive conversation will lead to a strong end-user engagement that will facilitate faster commercialisation and feedback to be the leaders in automatic gauging processing systems in the market. We will meet the technical challenges by utilising technologies at the forefront of Geometric Deep Learning over the last few years, particularly through investment from the self-driving car industry. The two main objectives to be addressed during Phase 1 are: to categorise 10 types of structure and vegetation; and to accurately record cant, curvature and clearance in 5 metre slices of point cloud and write these data to SC0 compliant with the National Gauging Database standard. To fulfil these objectives, our model will perform object identification and segmentation of 3D point clouds. To summarise, the proposed integrated model will remove the major bottleneck currently faced in industry (and highlighted as a key driver for this competition by Network Rail); so that they benefit from a safer railway for passengers and freight, through asset management; financial efficiency in terms of tedious manual labour expenditure; and access to an intuitive interface that brings new data sources and leads the way in predictive maintenance.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Atkins Limited	AUTOMATED SURVEY PROCESSING FOR RAILWAY STRUCTURE GAUGING	£99,756	£99,756

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Project description - provided by applicants
Currently the track side infrastructure such as platform, viaduct, tunnel etc. are scanned using laser measurement systems for Network Rail and categorized into structure types manually before storing in a National Gauging Database (NGD). The NGD stores information about the railway infrastructure and is used to calculate clearances between trains and infrastructure. Currently processing of survey data is a major bottle neck in structure gauging, with it taking years rather than months before data collected reaches the database in a useable format for gauging calculations. As a result much of the data is out of data in needs further human input to manage clearances and determine actions required to manage clearances for new train introductions. In some cases, this includes manual resurveying of platforms and other structures to obtain current information. This Atkins research and development project aims to improve data processing and availability by applying machine learning techniques using our expertise in developing Artificial Intelligence (Specifically Convolutional Neural Networks) processes to automatically classify the scanned data, as well as identifying any vegetation. The infrastructure data will be considered in a 3D Corridor Projection Space instead of 2D sections to provide better performance. This method will provide more greater confidence in the data leading to more accurate understanding of the clearances between structure and track. This will be achieved by the efficiency increases to process the data once the method is fully developed. This will lead to an NGD with more up to date, consistent and accurate survey data. A result there will be a reduction of survey data processing time with overall reduced costs and timescales for the introduction of new trains or cascading trains to new lines. SNC-Lavalin's acquisition of the Atkins group of companies created a global fully integrated professional services and project management company. Together, we have over 50,000 employees. Through integrating our workforce we deliver a compelling offer to our clients in the Railway and Transportation sector. This project will combine the skills of SNC-Lavalin's Gauging and Infrastructure teams and Atkins Software and Data Science teams, bringing together a technical team with all the key area.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
SNCF Réseau	Network Rail SGP - The Smart Gauging Pipeline	£82,000	£82,000

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Project description - provided by applicants
Network Rail Smart Gauging Pipeline Network Rail SGP is a fully integrated digital data production line. We use a broad spectrum of artificial intelligence techniques in order to analyze gauging data from infrastructures captured from the edge of railway tracks in an automated, reliable and durable manner. Our computer code is optimized to perform at all levels, but, above all, we place a special emphasis when optimizing our algorithms to the search for the lowest possible energy consumption, a major issue in processing data from point clouds, and more generally with high-intensity data processing .

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
SigmaRail	SiR, smart processing for smart railways	£92,988	£92,988

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Project description - provided by applicants
SiR, smart processing for smart railways Transport is a fundamental pillar of our economy and society, enabling economic growth and jobs creation. However, the railway industry must face critical challenges to guarantee passengers and freight safety as passenger's mobility increases (200-300% by 2050) and freight activity grows. Among these challenges, the efficient and successful management and operation of infrastructures is key for the improvement of the services offered by railway infrastructures administrators and operators. Maintenance, both active and predictive, is one of these major challenges. The railway industry is addressing it by putting in place a process of digitalisation. The advent of new sensors and technologies, such as 3D scanners and LiDAR, is helping the industry to cope with the first step in this process, collecting digital models from reality. However, the vast amount of data produced makes manual data analysis not practical. SigmaRail proposes to develop SiR, a deep learning and neural network-based system that will automatically process collected data and will provide useful insights of the railway infrastructures and assets status. Short term benefits include the improvement of the active maintenance services, as well as sets the base for the development of predictive maintenance analysis. Passengers and freight transportation will be notably safer and more efficient. This project intents to develop an innovative system, to apply forefront technologies such as neural networks to specific railway industry use cases.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Maestrano Group PLC (T/A Corridor.ai)	Bringing established gauging automation to Network Rail	£107,545	£107,545

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
BRINGING ESTABLISHED GAUGING AUTOMATION TO NETWORK RAIL: Corridor.ai will bring to the UK our internationally established cloud-based gauging platform for automated processing of rail intelligence from data - that we have developed and successfully applied on Australian and Japanese railways. The project we propose will enable Network Rail to benefit from our mature core technology: we will undertake the R&D required to create a bespoke application for them. This competition will allow us to work alongside Network Rail staff and their advisors to develop, test and demonstrate the new modifications that are needed to meet their particular requirements. This project should expedite commercial implementation so that Network Rail can benefit from radically quicker processing times to obtain actionable gauging information. Automating gauging data processing should also: improve rail workers' safety by reducing the need for (and frequency of) boots-on-the-tracks inspections; and improve flexibility for train operators and other Network Rail customers (and therefore railway passengers and freight users), by enabling faster and more accurate scenario testing etc.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Faculty Science Limited	Automated Structure Gauging	£108,000	£108,000

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Project description - provided by applicants
Using machine learning to improve trackside gauging. Trackside gauging is the process of determining the clearance between railway structures and passing trains - it is a critical component of maintaining the safety of Network Rail infrastructure and understanding the suitability of rolling stock for different train routes. Gauging has historically been a slow and costly operation requiring line closures, large amounts of manual work and sometimes years to return results. Faculty - a leading UK-based applied AI company - is partnering with the world's leading infrastructure firm AECOM to research and develop machine learning capabilities to intelligently detect and inspect railside assets and conditions to automate the gauging process for Network Rail. Working from LIDAR point-cloud data, Faculty will train supervised machine learning models using state-of-the-art research methods to detect and identify lineside assets as well as measure the cant, curvature and clearance along the line. These models will demonstrate the feasibility of automating the time-consuming process of creating survey files which are critical to provide Network Rail an understanding of track conditions and clearance. This project will build on cutting-edge machine learning and computer vision approaches that Faculty and AECOM have already deployed to automate the detection and inspection railside and roadside assets with optical video cameras. This includes current, in-flight research with Network Rail in which forward-facing-video is being tested for the highly-adjacent task of foliage encroachment detection. The new technology developed within this project has the potential to bring significant benefits to the UK rail sector, improving customer safety, reducing delays and costs. More accurate and timely understanding of the data will facilitate the introduction of new rolling stock and automating the survey process will reduce the amount of staff time spent on track.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Intergraph (UK) Limited (T/A Hexagon)	Faster and Higher-Precision Mobile Mapping through AI	£99,800	£99,800

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Project description - provided by applicants
Faster and Higher-Precision Mobile Mapping through AI. This challenge is in line with Hexagon's belief that a true modernisation of the rail industry lies in automating the various workflows that are common within the industry. To deal with the daily challenges that rail professionals are facing, Hexagon has been exploring and started developing the concept of mobile mapping: a sensor is installed on a train and at normal track speed qualitative data is captured which can be used for different analysis afterwards. The potential applications are endless! Hexagon is a pioneer and market leader in the development of both hardware and software solutions which already allow some of this potential of mobile mapping to be unlocked. The "Pegasus:Two" sensor captures high qualitative point cloud data whereas the "Rail:Factory" software is used to unlock the potential with the data that is captured. Not surprisingly both Pegasus:Two and Rail:Factory are currently already used in several production environments within the Rail Industry across the globe. Mobile mapping is a process that is subject to continuous improvement: both in our hardware and software we strive to improve. The hardware is continuously improved to capture more details while riding on the track; Rail:Factory is improved by continuously enhancing its capabilities and developing new features. For this project we aim to make a major step change in performance and outcome through in depth use of Artificial Intelligence (AI). Currently Rail:Factory is already able to classify structures and objects to a certain extent. The innovation we'll focus on during this competition will be to increase the intelligence of our software. We will train the software to derive more detailed classifications than the rough categories which currently can be discovered. When we achieve this there will be a major increase in the potential of mobile mapping. Hand-in-hand with more powerful sensors which can capture more detail, the intelligent software that uses the captured data can in the long run swiftly detect any potential risks like a damaged bridge, slumping embankment or encroaching vegetation near the tracks and signal this pro-actively to the maintenance teams. At Hexagon we believe the future of mobile mapping lies exactly there: data is captured swiftly and without causing any delays or putting any lives at risk, while quickly utilising the data as captured, automated processes using this data assist the Rail personnel to detect the most imminent problems, to prioritise and to maintain a highly qualitative rail infrastructure