Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Nov 2024

Project Reference Number

NIA2_NGET0080

Project Registration

Project Title

Visual Inspection and Condition Assessment Platform (VICAP3) - Bar by Bar

Project Reference Number

NIA2_NGET0080

Project Licensee(s)

National Grid Electricity Transmission

Project Start

December 2024

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Kerri Hayes

Project Budget

£488,300.00

Summary

VICAP 3 bar by bar will build on the success of VICAP 2. In VICAP 2, a refined artificial intelligence (AI) model was able to assess images of steel tower and automatically grade the level of corrosion of the steelwork. As part of the asset management practice, climbing surveys are carried out to get “bar by bar” (BB) assessments of corrosion on steelwork towers and to measure the extent of wear on fittings amongst other things. The aim of VICAP 3 is to develop algorithms and data collection methods which enable BB assessments and fittings wear measurements to be done using drone collected images. The expected benefits will be in assessment cost reduction and efficiencies.

Preceding Projects

NIA2_NGET0009 - Visual Inspection and Condition Assessment Platform for OHL Steelwork (VICAP)

NIA2_NGET0048 - Visual Inspection and Condition Assessment Platform for OHL Steelwork 2 (VICAP 2)

Third Party Collaborators

Keen AI

Nominated Contact Email Address(es)

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Problem Being Solved

National Grid Electricity Transmission (NGET) owns 21,900 steel lattice towers in England and Wales. Steelwork condition deteriorates through corrosion from exposure to chemicals that are present in the environment. Periodic assessments are made to understand the health of the network. Climbing surveys are carried out to get “bar by bar” (BB) assessments of corrosion on steelwork

towers and to measure the extent of wear on fittings amongst other things. This process is expensive, hazardous and infrequent.

The innovation project NIA_NGET0048 (VICAP 2) proved steel tower corrosion data can be graded using AI. This innovation project will develop algorithms and data collection methods which enable BB assessments and fittings wear measurements to be done using drone collected images. Hence, reducing the cost of assessment through a reduction in the number of climbing surveys and improvement in safety records.

Method(s)

In the previous innovation project (NIA_NGET0048), the ability of an AI model to identify and grade corrosion according to NGET standards was demonstrated. This project aims to develop algorithms and data collection methods which enable bar by bar assessments and fittings wear measurements to be done using drone collected images. Images collected from the drone will include internal steelwork surveys. With success, climbing surveys to measure the extent of wear on fittings (amongst other things) can be gradually phased out as they are expensive and hazardous.

Scope

The first part of the project is the corrosion to bar mapping. Here, Keen AI's corrosion detection and localisation algorithms will combine with positional data from a drone to assess the state of particular steel bars on a tower.

The second phase of the project will explore fittings wear measurement. Using known measurements on tower fittings, the localisation algorithms will be enhanced to determine whether there is wear on a fitting and its extent.

The third phase of the project will use drones with the latest obstacle avoidance technology to fly inside a tower and gather condition data. This data is then used to complete a full 360 degree tower steelwork assessment.

Key deliverables for the project are:

- Process for mapping images to regions of an 3D model with the ability to calculate extent and measurements.
- Metrological algorithms for matching of regions of known dimensions in an image and using these to measure wear.
- Bar by Bar of Corrosion for NGET tower created using "bar by bar" mapping algorithms.
- Measurement of Fittings Wear for fittings on a selected NGET tower created using "KAI Wear" algorithms.
- Process and guidance for collecting images to standard they can be processed by the "Bar by Bar" algorithms.
- Process and guidance for collecting images to standard they can be processed by the "KAI Wear" algorithms.
- UAV Collected images for Bar-by-Bar Assessment with requisite EXIF data.
- UAV collected images for fittings wear measurement.
- UAV collected images for internal "bar by bar" measurement.
- NIA Compliant Completion and Progress Report

Objective(s)

The objectives of the project are:

- To determine the state of each steel bar on a tower by combining Keen AI's corrosion detection and localisation algorithms with positional data from a drone.
- To determine whether there is wear on a fitting and its extent using the localisation algorithms and known measurements of tower fittings.
- Use drones with the latest obstacle avoidance technology to fly inside a tower and gather condition data. This data is then used to complete a full 360 degree tower steelwork assessment.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The project output will enhance the asset management practice by providing more detailed analysis and information of the steel work. This will improve system reliability and enhance the maintenance regime. There will be cost savings due to the efficiency of the asset maintenance routine. In addition, the improved bar by bar analysis and fittings wear measurement will reduce the need for climbing surveys. Consequently, there will be improvement in savings and safety records.

The project will have a positive impact as consumers will benefit from a more robust electricity system with additional reliability characteristics in its maintenance routine. The need for outages on the network will be minimized as the asset condition assessment procedure becomes automated and robust. In addition, the cost of maintenance may reduce, resulting in cost savings.

VICAP 3 bar by bar is in continuation of VICAP 2, with an overall aim of improving the asset management practice, cutting carbon emission, saving cost and enhancing safe system of work.

Success Criteria

The Project will be successful, if:

- The localised algorithm can assess the individual steel bars
- The localised algorithm can assess wear on the fittings
- A complete 360-degree steel tower can be provided from flight data of the internal steel structure.

Project Partners and External Funding

N/A

Potential for New Learning

In this project, the expected learnings include:

- The capability of the localised algorithm to provide the steel condition of each bar on a tower.
- How known measurements of tower fittings can enhance the ability of the localised algorithm to determine the state of wear on the fittings.
- The type of drone that can fly on the inside of steel towers to gather data and the safe system of work for the activity.

Scale of Project

The scale of this project involves the following:

- Data collection and processing;
- Presentation and documentation
- Development of the localised algorithm
- Internal steelwork survey using a drone
- Testing and optimisation of the AI platform.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The project will be carried out on computers and software (desktop exercise).

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£ 439,470

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

The aim of the project is to improve the efficiency of operations and maintenance of assets by providing detailed and automated asset condition assessment.

VICAP 3 bar by bar consolidates on the gains made from VICAP 2 by extending the assessments to every steel bar including the internal tower structure and the fittings. By broadening the scope of application of drones and AI, the project further reduces CO2 emission, increases throughput for inspection of a growing fleet of towers.

While the project does not clearly target vulnerable customers, customers will benefit from the turnaround effect in system reliability. The project will provide a more robust electricity system with additional reliability characteristics in its maintenance routine. The need for outages on the network will be minimised as the asset condition assessment procedure becomes more robust and AI driven.

The AI provides a cheaper, quicker and safer alternative to asset condition assessment.

How the Project has potential to benefit consumer in vulnerable situations:

N/A

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

Please provide a calculation of the expected benefits the Solution

The benefit will be achieved through a reduction in the number of towers assessed and the frequency of assessment carried out. With improvement in the data collection and processing, the need for assessment becomes more predictable which is guided by more accurate data. In addition, a reduction in climbing survey improves the safety index of the maintenance operation.

It has been estimated that within a period of 8 years, about £1.1 m could be saved from reduced climbing surveys and improved data collection and data analysis.

Please provide an estimate of how replicable the Method is across GB

National Grid has about 22,000 towers and the method of assessment can be replicated across all the towers.

Please provide an outline of the costs of rolling out the Method across GB.

The costs of deploying the new methods should be relatively inexpensive as it would require an update on the AI algorithm in the software. The actual cost will be known as the project develops and more learning is captured on the true capability of the AI model.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☐ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☐ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☐ A specific piece of new equipment (including monitoring, control and communications systems and software)

☑ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☑ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

During the previous innovation project (VICAP 2), we developed an AI model capable of identifying and grading corrosion. As part of this project, we hope to learn the following:

· How the localisation algorithms combined with Keen AI's corrosion detection can accurately assess corrosion on each steel bar.

· If known measurements on tower fittings will enhance the localisation algorithms to determine whether there is wear on a fitting and its extent.

· Whether the drone can capture all relevant data required for the internal steel survey and the safe system of work.

Fundamentally the introduction of AI is a huge opportunity for Network Operators to run networks at a lower cost to the consumer. This project will demonstrate to other Licenses how this can be done in a transformational way.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

N/A

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

There is no awareness of any similar project that uses AI to assess the bar-by-bar condition of steel towers bars and wear of fittings.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

The previous innovation projects (VICAP 1 and 2) developed an AI model able to detect and localise corrosion on towers as well as grade the corrosion. VICAP 3 bar by bar is pushing the bounds further by implementing holistic tower corrosion mapping including internal steel work. In addition, VICAP 3 will evaluate the condition of fittings wear, thus providing a 3D schematic of the tower condition for each steel bar.

Relevant Foreground IPR

The following Foreground IPR will be generated by this project:

- Steelwork survey imagery assessed by the AI algorithm
- Fitting wear assessed by the AL algorithm
- A set of labelled steelwork images assessed internally by the drone
- A report of on the rate of deterioration by tower and grade
- The 360-degree schematic of the steel tower

Keen AI's corrosion assessment localised algorithm is relevant Background IPR.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click 'Contact Lead Network'. National Grid already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at https://www.nationalgrid.com/uk/electricity-transmission/innovation
- Via our managed mailbox box.NG.ETInnovation@nationalgrid.com

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

The project has some risk associated with the development of the AI model. An enormous amount of data is required to train the AI model and validate its operation as fit for purpose. A significant hurdle will be the assessment of fittings wear by the localised algorithm which would require substantial data and resourcing. As such, it is a good fit as an innovation project.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

The project involves considerable research and development as such possess some risk making it a good fit as an innovation project.

This project has been approved by a senior member of staff

☑ Yes