SIF Project Registration

Date of Submission

Apr 2022

Project Reference Number

10025731

Project Registration

Project Title

Digital Twins: Exploring the commercial, societal and operational benefits on green hydrogen projects

Project Reference Number

10025731

Project Licensee(s)

SGN

Project Start

March 2022

Project Duration

2 Months

Nominated Project Contact(s)

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Project Budget

£124,265.00

Project Summary

SGN propose to collaborate with partners to build a "data first" approach that explores the role of digital twins as green hydrogen project SIF innovation project. The overall "intent" is that digital and data is part of the "product" and part of the "design" with the capture, storage and transmission of data built-in from the design stage.

The work aims to meet the key challenges within Ofgem's aims and objectives for the SIF challenge. SGN suggests that the project could shape how a future hydrogen industry could be organised in terms of information and data transfer between producers, gas networks, suppliers, consumers - for example, linking power, water, and gas data infrastructure in the specific H100 Fife case, and building on opportunities to expand into other developing hydrogen projects.

The insights gained from the vast amounts of available information will have a profound impact on how the emerging hydrogen economy will sustain itself in the future. Such incidents are usually due to various mechanical failures, which digital twin products are ideally suited to help customers manage and mitigate.

With the increasing availability of economically viable real or near real-time information via sensors and inbuilt health diagnostics encompassed in the industrial IoT, the challenges of managing and using information smartly are rapidly increasing. Overcoming these challenges comes with outstanding potential benefits for our customers, when they are able to reduce unscheduled asset downtimes, improve asset efficiency, reduce environmental impact and eliminate regulatory compliance infractions.

SGN proposes to work with partners to test a number of hypotheses; In the digital twin space, DNV have produced the first methodology and recommended practice for the Qualification and Assurance of Digital Twins. On this project DNV will draw upon the rich insight from working with multiple cross-industry stakeholders on digital twin initiatives alongside deep gas industry domain knowledge.

AWS is a cloud computing industry leader, with a business innovating in new areas such as Machine Learning and Internet of Things which will help the project to ascertain real time data of user interactions to answer the questions on green hydrogen in order to make data-driven decisions.

NGGT will bring knowledge and learnings to SGN to best align data and digital systems -- they will also be collaborating on the Gas Network Interoperable Digital Twin SIF to share knowledge and bridge gaps around digital systems to enable a collaborative approach around future Digital Twins.

Third Party Collaborators

AWS

DNV

Nominated Contact Email Address(es)

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Problem Being Solved

The recent publication of the UK's hydrogen strategy (August 2021) places considerable focus on the role of digital and data as critical enablers that can support the emerging role of hydrogen -- particularly low-carbon hydrogen – in achieving net zero. We believe that a strong use can be built that unites these ambitious hydrogen development plans alongside the work in the digital and data space that is being chaired by the Energy Data and Energy Digitalisation taskforce(s).
H100-Fife is a world-first green hydrogen-to-homes network that will demonstrate 100% green hydrogen heating in homes for the first time. It embodies the UK's commitment to taking action in the global fight against climate change. Helping to deliver the UK's net zero target for 2050.
The unification of these two concepts forms the basis of our project, which for the purpose of the SIF "discovery phase" will explore the commercial, societal and operational benefits that could be derived from the deployment of a digital twin concept on a green hydrogen use case.
The overall innovation and challenge question(s), or problem(s) that is intended to be explored as part of this concept are:

- How can a digital twin of a green hydrogen project support an emerging hydrogen economy in a safe, resilient, innovative and effective way?
- What are the commercial, societal and operational benefits that can be derived from the deployment of a digital twin concept on a green hydrogen use case connected to the H100-Fife project?
- What skills are needed in industry to support the design, build and operation of such as twin?
- How can the data generated from such as twin enable a digitally-rich ecosystem that puts the energy industry at the forefront of cutting-edge digital technology and processes and support the strategic ambitions of the UK Government as outlined in the UK Hydrogen Strategy?
- How does the hydrogen economy interact with the other infrastructure such as the impact on electricity supply resilience, water supply and other potential end users such as transport and industry?
- How can digital twins in form and empower the customer and help to enhance trust between an end-user and clean energy providers; increase societal uptake; support future billing methodologies; and provide clarity about the provenance of the energy source.

A digital twin concept could see increased connectivity between industry, the shipper / supplier and the customer.

Project Approaches And Desired Outcomes

The Big Idea

Working in conjunction with DNV, technology partner AWS and NGGT, SGN will strive to ensure that the end-result -- a working green hydrogen digital twin, combined with analytical tools and machine learning, will provide a platform that changes the traditional way of how we look at the analysis of asset condition and performance. It will enable a new generation of advanced predictive analytics and provide a virtual environment where process control and operational solutions are designed and tested before being applied to the live plant, reducing risk when upscaling electrolysis plant design for example.
In this initial discovery phase the project will aim to

- Build user stories such that the overall benefit of using a digital twin on a green hydrogen project can be fully articulated to industry -- using H100-Fife as a use case.
- Understand key data attributes that need to be captured, tracked, traced and stored throughout the project and key actors involved. Define a conceptual solution architecture and build a detailed benefits case.
- Scope a potential "alpha" phase for the work.

Clearly identifying the "entry" and "exit" points of hydrogen through data and highlight key hand-offs between producer, distributor, supplier/shipper and consumer, generating tremendous insight for both SGN and industry at large.
SGN believes that the high-level scope outlined within meets the overall competition criteria outlined by Ofgem within the conditions of the SIF.

- This project will challenge the status quo and the way that data and digital is used across the energy system through a real-world concept. It will build operational, financial and societal concepts, with digital providing the means to support this.
- Supporting a concept of "build quickly and fail fast" -- a critical mindset change required to support the drive towards achieving net zero.
- The overall intention would be to demonstrate to industry as a whole that improving usage and adoption of digital technology can be used to increase consumer choices and bolster the efficiency, security and resilience of the networks.

Currently the idea is very much at a conceptual stage. With any future digital twin being built on AWS technology, the solution will come with benefits such as: 1)

- Unmatched security features.
- Limitless scalability for IoT data velocity and volume, storage, machine learning processing, compute needs, increased user loading, etc.
- Eliminating data silos between internal organizations while making data available to external stakeholders.
- Interoperability with partner digital twin solution through API-based architectures.

Innovation Justification

The digital twin community within the United Kingdom is very active, thanks in the main to the activities coordinated by the Centre for Digital Built Britain, located at the University of Cambridge and (part) funded by BEIS. The Digital Twin Hub resource run by the CDBB encourages industrial use cases to be submitted and to date there are no "hydrogen" digital twin activities. The very ethos of the CDBB is about building an ecosystem of connected digital twins -- or a national digital twin.
We propose to use the concepts built into the CDBB's Gemini Principles on our project and ensure that our twin will be "connectable" to future industry twins such as power, water and renewables -- all complimentary to the green hydrogen digital twin we are proposing.
Portsmouth International Port is working with IOTICS to build a digital twin of their port, which includes gathering data from an onsite hydrogen electrolyser. Our project is different, though, in that it is aimed at a complete "system" with a strong hook to the customer with the economic and societal benefits previously outlined.
SGN believes this proposed concept is multi-faceted and truly innovative in nature. For example, the data captured from the wind turbine at Levenmouth will provide insight into energy production in terms of electrons -- this is turn will feed the electrolysis process, which in turn will create insightful data about the hydrogen molecules. This insight can potentially be followed through the entire supply chain through sensor and IoT technology, through to the customer premises, facilities and meter. It could also influence future billing methodologies and influence future local authority investment priorities.
Furthermore, there are key learnings that can be gleaned from the work others have done in this area; for example, AWS are utilising digital twin technology as in diverse industries such as energy (Woodside Energy's liquefied natural gas processing facilities, manufacturing (Atos digital twin platform for shop for real time insights, and sports (National Football League using player digital twins to model scenarios and combat injuries). The UK Government's August 2021 publication of a UK Hydrogen Strategy describes the criticality of developing a hydrogen economy that requires tackling the 'chicken and egg problem of growing supply and demand in

tandem'. Hence SGN believes that timing is perfect with respect to further exploring the role of digital and data to support these grand ambitions.

Project Plans And Milestones

Project Plan And Milestones

In this initial discovery phase the project will break the work into two work packages and will:
Exploration

- Hold a project initiation workshop.
- Build user stories such that the overall benefit of using a digital twin on a green hydrogen project can be fully articulated to industry. DNV with SGN / AWS.
- Hold initial discovery workshops with key stakeholders.

Conceptual

- Understand data elements that are important to capture as part of a "green hydrogen" project (SGN and DNV).
- Understand key data attributes that need to be captured, tracked, traced and stored throughout the project and key actors involved (SGN and DNV).
- Define a conceptual solution architecture based on the concept (AWS).

In addition we will

- Undertake project assurance (National Grid) will have the role of assurance in this project, bringing information from their interoperability project to align with this project and any learnings through their NIA funded CVDT programme to help support the activity and ensure future collaboration.
- Scope a potential "alpha" phase for the work (ALL).
- Deliver a discovery phase report (ALL).

We propose weekly sprint activities run over the total project timeline of two months, the culmination of each will result in a deliverable associated with each of the bullet points, above.
The key metrics that we intend to use on this project to measure success are: -- mental (or knowledge); social (or societal); and economic (or commercial). In the project initiation phase we will set up tools to capture these metrics; using percentage terms.
A risk register has been constructed which outlines the type of risk (time, technical, financial etc.), the likelihood, impact, mitigations and a score. Any risks at the upper end of the scale will be further mitigated. All technology specific risk will be identified using the technology qualification process DNV-RP-A204 (Qualification and assurance of digital twins). Technology threat assessments will identify the technology risk early in the project, allowing risk mitigations to be developed as part of the agile approach. Unintended access to any digital twin could give hackers an opportunity to gain access, posing a loss of intellectual property and data, and risks to the supply chain including loss of life through tampering with the energy supply. Therefore, a systematic cybersecurity strategy is recommended to eliminate gaps that can occur between the physical and digital security mirroring and ensuring ongoing hardening of the end-to-end solution.

Route To Market

Digital twins have the potential to profoundly impact on almost all areas of our life. They are expected to have a significant impact on our achievement of net zero and our changing environment, improving our ability to predict renewable energy generation rates days in advance, as well as our expected usage as a nation and even model changing weather and ocean conditions.
We aim to use our innovation to support the broader energy industry objectives, build knowledge and competence in data; modernise energy data access; and ignite innovation across industry through innovation initiatives such as Digital Twins. We are completely aligned with a whole systems approach and will ensure that our digital twin solution is interoperable -- we are strategically aligned to the Centre for Digital Built Britain and associated stakeholders. We will share our learnings and knowledge from our project to provide insight into the broader industry and societal benefits -- and any resulting technology driven digital twin should continue to be "interoperable" to other Digital Twins (water, gas, electricity) to ensure a whole-system approach for a modern UK energy system.
Our concept should see increased connectivity between industry, the shipper/supplier and the customer -- all enabled by data, which will act as a key enabler for:

- Improving visibility and commercial viability through data.
- Providing assurance of the energy source and its provenance to allow the customer to make more informed financial and societal decisions.

- Enabling operators to obtain proof that they can trust the information provided
- Demonstrate adherence to government policies and regulatory requirements.
- Derive value or facilitate monetary exchange.
- Build trust and improve perception with the public, industry partners and collaborators whilst demonstrating that hydrogen injected into the network is fully accounted for as it is supplied to the customer.

To be commercially and operationally successful, potentially creating commercial sandboxes for organisations to trade. Drive transparency, innovation, and acceleration of data related net zero projects.
Bring data and digital twin management activities to the fore, including digital twin solutions architecture, digital twin technology, digital/data twin model specifications and data quality management and assessments.
Cloud technology, such as from AWS, has enabled software-based solutions to become almost ubiquitous within our everyday business activities, and we believe will enable the same outcome for this digital twin solution.
Learnings from our project will have broader industry and societal benefits -- resulting digital twin should be "interoperable" to other digital twins.

Costs

Total Project Costs

265324

SIF Funding

124265

This project has been approved by a senior member of staff

☑ Yes